# SCIENTIFIC AMERICAN

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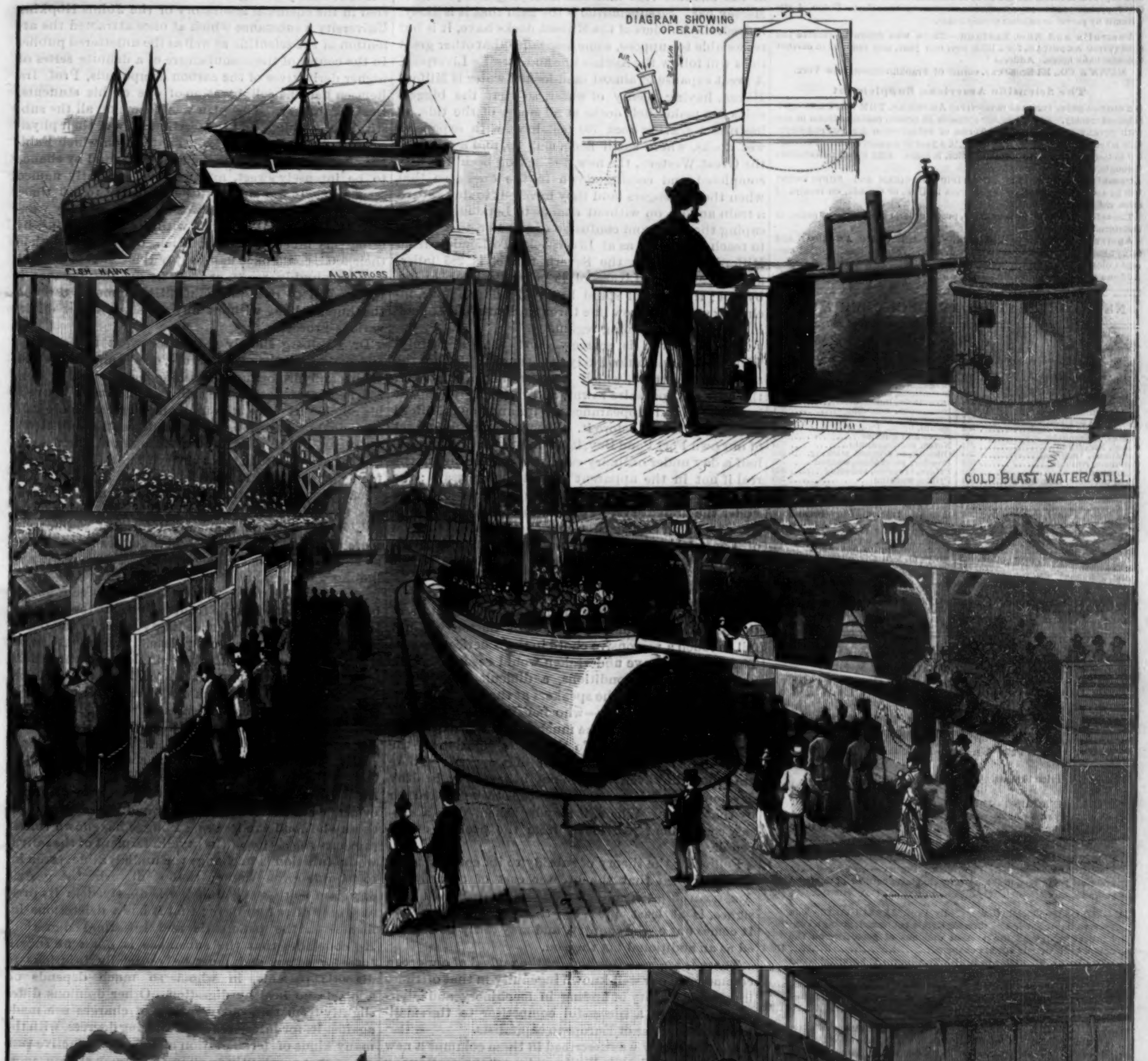


THE MARITIME EXHIBITION AT BOSTON MASS.—[See page 358.]

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## SHORTENING THE OCEAN TRIP HALF A DAY.

The steamer City of Rome, on her last trip out, made the port of Milford Haven instead of Liverpool, the magnificent system of docks, long under construction at that port, having been at last completed, at an expense of $5,000,000. The completion of these docks at Milford Haven is an important event, marking as it does the first practical step in the development of the project to join Fort Pond Bay, at the eastern extremity of Long Island, with the nearest harbor on the British coast for ships out of New York. The substitution of Milford Haven for Liverpool as a terminus saves the delay in steaming up St. George's Channel and up the Mersey, and, more important yet, avoids the dangers of the channel fogs and the annoying delays off the Mersey bar. So substantial is the gain that it is likely, indeed, the builders of the Milford docks have, it is but reasonable to suppose, some assurance that other great lines will follow the Anchor line and forsake Liverpool. A great expanse of almost land-locked water is Milford Haven, having plenty of water, so that the biggest ships can make their docks at all stages of the tide. It has now a graving dock 700 feet long, with expansive wet docks, where small fleets may lie, and a railroad, the Great Western, the new line having been recently completed and coming down to the docks, so that when the passengers land they have but to step aboard a train and go on without change to London, thus escaping the delay and confusion of transfer to a tender to reach the docks, as at Liverpool. To London from Milford Haven *via* the Severn tunnel is 285 miles, against 201 from Liverpool, it being 1¼ hours longer by rail; the rate of speed being 46 miles an hour, including stops, the new line through South Wales passing through a charming region.

Milford Haven is scarcely more than a pastoral Welsh town, and is not likely to perceptibly detract the trade of Liverpool, which has thriving Manchester, the bustling Yorkshire towns, and the rich Midlands at its back. Yet, if appearances go for anything, Milford has a great future before it. Even without the adjunct of our own Fort Pond Bay, it insures the saving of quite half a day under ordinary conditions of weather in the real if not in the apparent transatlantic passage; the official time of east-bound steamers stops at Brow Head under the present system of running; and if the project of making a western terminus at the eastern end of Long Island should be put through, it will, it is claimed, shorten the ocean trip by a full 24 hours.

## A PLEA FOR THE MERCHANT FLEET.

The patriotic sentiment animating the projectors of the National Maritime Exhibition in Boston will not fail to touch a responsive chord in the American breast. The task they have undertaken would seem, at least, under the present conditions, a difficult one. There are some—nearly all the speakers at the opening ceremonies are among them—who believe that all that is wanted to bring about the much to be desired end is government subsidy. To them the solution of the problem rests upon the humor of Congress. There are others, however, who do not believe any healthy development of deep-sea commerce is to be looked for by that means. Where, it may be asked, does a subsidy come from? Obviously from the pockets of the people.

Following the theory of subsidy to its conclusion, it is readily seen that the greater cost of carriage by American ships, if not all paid by shipper and consignee, is at least paid by their own countrymen. It comes out of the country, and may fairly be regarded as an additional tax thereon.

There is a reasonable hope of the revival of our ocean commerce in our well-known ingenuity in that ofttimes illustrated faculty of finding in machinery and labor-saving devices a successful competitor to the small-profit adventures of European capitalists.

Quite recently was described in these columns a new war ship built by Sir William Armstrong's company for the Italians; a ship which, in point of effectiveness, is said to be far in advance of anything the world's costly navies can show. If the promise of this ship is realized, then not even the costliest ship would be able to compete with it in its vocation of war. If this has been the experience in the war fleet, why may not the same occur in the merchant fleet? Should Yankee ingenuity discover a type of cargo-carrying ship that will take more cargo at greater speed with the same or less fuel, the thing is done. Then neither the less cost of the European ship, the poor pay and poor food of its crew, nor even the fact that its owner is content with a low rate of interest on his capital, will suffice as a barrier against American competition.

Who can say what the ship of the future will be like? The principal cargo of the earlier paddle-wheel steamers, even those of the famous Collins line, was the coal to be used in driving them across the ocean. Then came the screw. If the advantages of the new type, that which is yet to be discovered, should be so important as the advantage of screw over paddle wheel, it would have the pick of the ocean traffic, and the British merchant steamer, as now constructed, could not compete with it. It is the opinion of some that oil will supersede coal as fuel on the high seas. Perhaps electricity will follow oil.

The field for investigation and experiment is broad, the prizes many. The present exhibition, with its consecutive groups of models showing the progress of naval construction, and with its collection of facts and figures concerning ocean commerce, offers an excellent opportunity for the student and artisan. Perhaps from this or similar efforts the germ will come that will once more give us command over the seas without recourse to so senseless and futile a policy as that of hiring ships to show the American flag.

## SACCHARIN, THE SWEETEST OF SWEETS.

About nine years ago there was accidentally discovered in the chemical laboratory of the Johns Hopkins University a substance which at once attracted the attention of the scientific as well as the unlettered public. In the course of the manufacture of a definite series of higher derivatives of the carbon compounds, Prof. Ira Remsen had the collaboration of one of his students, Dr. C. Fahlberg. The plan was to make all the substitution products, and to ascertain a few of their physical and chemical properties. That one on which Fahlberg happened then to be engaged was found by chance to be intensely sweet, and was subsequently named saccharin. It was shown to be from 280 to 300 times as sweet as cane sugar, and was deemed especially valuable in medicine. Sufferers with *diabetes mellitus*, by using very much diluted solutions of the chemical in their food, could once more enjoy the "sweets of life." It came highly recommended by doctors, because it was known to pass in quantitative amounts through the human body without any apparent effect on its various processes.

Dr. Fahlberg shortly thereafter went to Germany, and undertook the manufacture, on a commercial scale, of this anhydro-ortho-sulphamine benzoic acid or benzoic sulphinide, otherwise called saccharin, and gave it his name. At once it found quite extensive use as a medicinal preparation, as an adulterant, a substitute for sugar, and the like, both in Europe and, there is reason to believe, also in this country. The impure product for sale in the markets sells at about $15 per pound. Prof. Remsen, who still continues work in the same series, states in a recent article in the *American Chemical Journal* that the commercial form of saccharin is more than one-half impure, and estimates its sweetness as but 125 times that of sugar. It dissolves readily in boiling water, and has several interesting derivatives with sweetening power. One of these has been found to be intensely sweet in the front part of the tongue, neutral in the middle, and exceedingly bitter in the posterior portion near the soft palate. The investigation with this compound is the best single proof that there exist in the tongue two sets of specific nerve fibers, corresponding to these two kinds of sensation. Thus it will be seen that there have been some advantages from the discovery and the prominence given this new substance.

But this has been more than compensated by the train of evil that everywhere follows in its path. Authorities differ somewhat on this, but the weight of evidence lies both in the number and the reputation of those who condemn its use. Pflugge has shown that it prevents the action of the ptyalin ferment of the saliva, whose function is to change the undialyzable starch into soluble grape sugar; that it disturbs the gastric digestion, so that egg albumen is dissolved in its presence only after four days; that it has a deleterious influence on the pancreatic and intestinal digestion. He concludes that the substance is not a fit substitute for sugar, and must be especially injurious to diabetic patients, in whom so much depends on a good and healthy digestion. Other opinions differ slightly from this, but a variety of charges are made against it, for interference, in varying degrees, with the many kinds of fermentation and the putrefactive processes that constantly go on in the human system, most of which are connected with digestion, and all of which are beneficial. Brewers have found a use for saccharin, not as a sweetener, but more as a preventive of diastatic fermentation, the like of which is performed in certain parts of the digestive tract in man. These are, therefore, likely to be hindered by the adulterant in this favorite beverage.

Its use has been made the subject of legislative action in Belgium, Spain, and France. The Belgian Academy proclaims that it is not a food stuff, as it does not represent the nutritious value of sugar, since it seems to pass unchanged through the body; that its application as a sweetener in food preparations and drinks appears to be followed by injury to the health; and that manufacturers are therefore warned that they must give ample notice to the consumer of its presence in articles of food. In Madrid it is called an adulterant, foods containing it are forbidden to be sold under penalty, while the article itself is heavily taxed. The French government, some time ago, put saccharin under a temporary ban as a substance possibly injurious to the health. Now it has definitely pronounced against it as a drug, food product, and adulterant, and has put an almost prohibitory tariff on its importation.

Little has as yet been heard from this saccharin in public here in America, save as a chemical curiosity. But there seems to be a disposition among chemists to believe that it is extensively used. Our medical experts in the various laboratories of cities and States where adulterated articles and harmful drugs are sought out and the criminal processes of indictment begun, should direct their attention to this, which is undoubtedly a deleterious substance. The good of the country should also be consulted by the specialists in the Chemical Division of the United States Agricultural Department at Washington. Let them ascertain if the charges against saccharin be true, and, if so, let them advise that measures be taken to prevent its coming into more general use than has hitherto fortunately been the case. And if these charges should be proved, Congress should, like the authorities in France, put such a high tax on it as will prevent its importation. Dr. Fahlberg has a patent on the method of making his product, in this country, and thus we shall be spared the danger altogether.

### Smokeless Powder Wanted by the Government—a Chance for Inventors.

The subject of smokeless powder for military uses occupies considerable space in the annual report of Brigadier-General Benet, Chief of Ordnance, just issued. The report says:

"In the absence of a suitable small-arm powder there has been no substantial progress in the matter of a small caliber rifle beyond what has been heretofore reported, except in the negative gain resulting in the apparent abandonment, or tendency that way, abroad of all powders but the so called smokeless.

"This change, involving the return to a grained powder, is, if permanent, an appreciable gain for all in economy and efficiency of the product in the manufacture of small-arm cartridges, and may have been brought about as much from the difficulty of obtaining uniform and satisfactory results in the way of velocities and pressures with the compressed powders, as from the more valuable properties of the smokeless.

"No American has yet submitted for trial a smokeless powder, and experiment with compressed powders has shown the same eccentricity as developed abroad, tending to destroy confidence in the final production of a serviceable compressed powder cartridge.

"All effort, official or otherwise, to date, to obtain a smokeless powder has been abortive, and American powder makers and chemists have not yet awakened to the lucrative opportunity presented to them. There is reason to believe, from an application made to an officer of the Ordnance Department more than ten years ago, that smokeless powders originated, like many other inventions, in America, only to be brought to the attention of the world in foreign countries, although in this instance the person concerned met with encouragement of which he did not avail himself.

"In view of the present status of the powder question, it is not deemed expedient to produce a small caliber rifle for compressed powder cartridges. Such rifle, however excellent in itself, would be inferior to foreign arms using smokeless powders, and consequently unsatisfactory to the army and the country at large. It is believed, however, that all the elements entering into the problem, except the powder, are ready for use the moment this powder is obtained. A thirty caliber rod bayonet Springfield rifle has been made, and a rod bayonet thirty caliber magazine arm is now in progress of construction, in anticipation of the final acquisition of the much needed powder, so that no time may be lost in presenting for trial both single-loading and magazine small caliber rifles."

### Utilization of Coal Dust.

The Reading Railroad officials, headedby President Corbin, recently visited the company's coal plant at Mahanoy City, Pa., to inspect a new process of making fuel from coal dust. Heretofore about one-seventh of the product of the coal mines has been lost in dust. It is now intended to utilize the dust by making it into bricks that will burn like hard coal, except that there are no clinkers, as the bricks burn to ashes. The new process consists of the coal dust being evenly distributed with one-tenth per cent of pitch. This by an ingenious contrivance is pressed by great machines into large cakes, steam being used to moisten the mass. So hard does it become that it possesses the same power of resistance as coal, or, in other words, a hundred pounds of pressed coal dust will last as long as the same amount of hard coal. A pressure of thirty-five tons is brought to bear on each brick. There are two presses in operation, which, when run to their full capacity, will turn out about eight hundred tons of the bricks in twenty-four hours. The bricks take up 25 per cent less space than ordinary coal, and in consequence an engine can be loaded to go one-fourth further without replenishing the supply of fuel. All the officials expressed themselves very much gratified with the new process. A company has been formed, with Austin Corbin as president, for manufacturing this fuel.

### PHOTOGRAPHIC NOTES.

*The Pyro Developer.*—A pyro solution recommended for its keeping qualities by the *British Journal of Photography* is made up as follows:

| | | |
|---|---|---|
| Pyro | 1 | pound. |
| Recrystallized sulphite soda | 5 | " |
| Citric acid | ¼ | oz. |
| Water (if boiled, so much the better) | 2 | gal. |

The solution will keep for several months without becoming discolored. Ammonia potash or carbonate of soda all work well with it as an alkali.

*Reducing Over-developed Bromide Prints.*—In a communication to the Photographic Club, Mr. Adolphe M. Levy stated, as reported in the *British Journal of Photography*, that his experiments showed that a print could be reduced by immersing it for fifteen minutes in mixed ferrous oxalate and hyposulphite of soda solution, the latter being made in the proportion of one ounce old ferrous oxalate to twenty of hypo. solution. The hypo. was made of strength of 3 ounces to one pint or 16 ounces of water. The cause was attributed to the formation of a small quantity of ferric chloride salt, which exercises a strong reducing effect on the silver salts. Other experiments were tried by immersing the print first in a ferrous oxalate solution and then in a hypo. bath, which produced a similar result.

*Washing Prints.*—Mr. Augerer's method of washing prints is as follows: After a first washing in a pan, the prints were laid on a sort of sloping desk formed of a plate of ground glass with the ground side upward, and over them a constant spray of water is kept playing. Meanwhile the prints are continually rolled with a glass roller mounted in a fork handle, like a printer's inking roller. This method, now employed in many establishments, seems to rapidly and repeatedly remove—by the pressure of the roller—the saline solution from the pulpy mass of the paper, replacing it by water each time. Indeed, there are several systems for washing prints which involve the same principle of pressure and release while the print is subject to the action of water.

### Some Curious Wills.

The St. Louis *Republic*, some time ago, had a chapter on wills, showing the testators to have possessed minds singularly constituted.

Often quoted is the remarkable will of Solomon Sanborn, of Medford, Mass., who died about fifteen years ago. Sanborn was a great patriot, and specially gloried in the part Massachusetts took in the revolutionary struggle. In his will he left his body to Dr. Oliver Wendell Holmes and Prof. Agassiz, not, however, without imposing some of the most unheard of provisions and conditions. His skeleton he desired prepared in the most artistic manner known to the profession, and placed with the many others in the anatomical department of Harvard College. While preliminary preparations were being made in carrying out this extraordinary request, he desired the surgeons to be very careful with the skin so that it could be tanned in pieces of sufficient size to make a pair of drumheads. Upon one of these drumheads the "Declaration of Independence" was to be written, and upon the other Pope's "Universal Prayer." Fitted in its proper wooden frame this ghastly relic was to be presented to a local drummer, whom the testator designates a "distinguished friend," upon condition that he would promise to carry it to the foot of Bunker Hill monument on each succeeding anniversary of the battle, at sunrise, and beat upon it the invigorating strains of "Yankee Doodle."

The skeleton of Jeremy Bentham, in the Hospital Museum, London, is there at the request of its owner, who made a special provision in his will to have it presented to the curators of the hospital, who, upon accepting the gift, were to have the skeleton mounted and put in the presidential chair at each meeting of the hospital directors.

Dr. Wagner, an American, is up to or even ahead of the English precedent in the dismemberment idea. During his life his relatives had given him but little thought. When it came time for him to die—he had a little money, about $1,000—his brothers became very kind. After his death, when the will was read, the following remarkable clause was disclosed:

"To my brother, Napoleon Bonaparte, I bequeath my left arm and hand; to George Washington, my second brother, my right arm and hand; to my other relatives my legs, nose, and ears. My money, $1,000 cash, now in the B—— Bank, I bequeath to the physicians and surgeons who carry out my request by dismembering my body and giving to each of my relatives the portion allotted to him or her."

Horatio G. Onderdonk, a brother of the Bishop of New York, made provisions in his will which would have turned old Draco green with envy. Draco was strict, and well understood the meaning of the expression "ruling with a rod of iron;" but had Mr. Onderdonk lived at the time the old man was preparing his famous code, he could have helped to make it more binding. The last paragraph in the Onderdonk will read as follows:

"No heir must be an idler, sluggard, profligate, drunkard, gambler; use liquors or tobacco; go hunting or fishing on Sundays; attend races; enter a barroom or porter house; neglect to rise, breakfast, and be ready for business by 9 o'clock; or get married before he or she arrives at the age of 25 years."

### Great Fires at Lynn and Boston.

On November 26, the city of Lynn was visited by fire, and some eighty acres were swept by the flames, and property estimated at five millions of dollars was destroyed. Lynn is devoted to the shoemaking industry, and has ranked as the largest shoe manufacturing city in the world, and the factories of this and allied industries were the heaviest sufferers.

Two days later, on Thanksgiving day, November 28, the city of Boston was the sufferer. At 8 A. M. fire was discovered in the upper story of a building on the corner of Bedford and Kingston Streets. From the same box which had been used in the great fire of November 9, 1872, an alarm was sent out, but before the flames could be subdued a large number of buildings in the dry goods district were destroyed and damages to the extent of over five millions of dollars were inflicted.

In the fire of 1872 much damage was done by escaping gas. The Boston Gas Company, as one of the outcomes of that experience, put in a number of valves in the line of their street mains. The precaution proved to have been well taken, and the gas was shut off from the burning district in time to avoid any additional trouble from its presence.

The recent fire has been attributed to the electric overhead wires. The crossing of an electric light wire with one of the wires of the Boston Time Company has been assigned as the cause. Many or all of the clocks manufactured by this company stopped a few minutes before seven o'clock in the morning. During the progress of the fire, the overhead wires were found to interfere very seriously with the firemen's work, emitting sparks and scintillations freely. This proved there were plenty of live wires at the hour in question.

The overhead system of distribution of heavy currents, whether of low tension or high tension, is a menace to life and property.

Any system of electric distribution in which crossing of wires carrying modern light or power currents is possible involves danger to the community. As long as such systems are permitted to exist, their dangers will receive additional illustrations.

### Health and Spirits.

Whatever may be thought to the contrary, the standard of health is as liable to fluctuations as the weather. The barometer is, in a measure, the gauge of the state of the weather, but we have no instrument for estimating even with an approach to the truth the state of the vitality of any individual. The customary salutation, even when replied to in the usual adverbial manner, is certainly no accurate criterion of the state of the health, since a general paralytic often *feels* much better than he has any physiological right to do. And, in opposite fashion, a man who does not know how he feels may be in first-rate health, or at least in a splendid condition for opposing those forces which are constantly tending, like the force of gravity, to bring a man to earth. Every one knows, in greater or less degree, that which makes for his physical welfare, but it is not always realized to the fullest extent that an improvement in the *feeling* of health is by no means always desirable in the interests of longevity. To feel extraordinarily well costs much, and the excessive expenditure of mental force may derange a considerable number of corporeal functions. The desire to want to be in good "form" requires restriction in the case of many nervous individuals, whose powers are not always equal to their appetite for high spirits.—*Lancet.*

### Importance of the South American Trade.

No other country in the world can manufacture such excellent tools and machinery as the United States, and in no other country are the prices for high grade articles of that kind lower than they are in the United States.

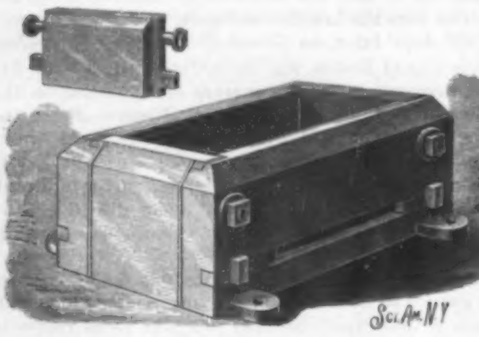
Yet of the $2,219,000 worth of tools and machinery that the South American republic of Chili purchased in 1882, only $211,000 worth, or less than one-tenth of the whole, was purchased of us. More than $2,000,000 worth was purchased from England, Germany, and France.

On such a showing as this, is there not something manifestly wrong somewhere? Ought not our manufacturers and merchants make more of an effort to obtain this trade than they have done? It would seem to be the best foreign market open to us.

To prevent oilcloth, patent leather, and similar materials from sticking together when rolled, purchase a few sheets of paraffine-impregnated or otherwise prepared paper, and roll with the material. This will prevent the sticking. It will also prevent the fading of the colors or gloss by keeping out air and moisture; the evaporation of the oil is likewise prevented to a great extent.

### AN IMPROVED BRICK MOULD.

A simple and durable brick press box, arranged to take up all wear, is shown herewith, and has been patented by Mr. Alexander Paul, of Meyersdale, Pa. The sides and ends of this box are preferably made of cast iron, with the inner faces chilled, or of steel, the parts being fastened together by bolts or wedges and keys, or by both, as shown, while at the bottom, on the sides, are the usual ears for securing the box to the bed plate of the brick-pressing machine. The bolts pass through corresponding apertures in the sides and ends of the box, and the wedges through

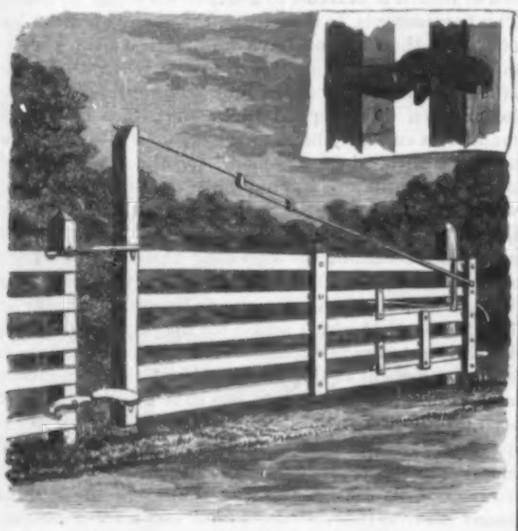



PAUL'S BRICK MOULD.

apertures in lugs extending from the ends, the wedges lying in grooves formed on the outer surfaces of the sides. Each of the ends has on its side edges transversely extending lugs or projections fitting into corresponding grooves in the sides, and at this joint are placed strips or liners, with wedges on the outer sides, permitting of easily refitting the box when its sides and ends are worn out. Between the ends and the sides are additional strips adapted to serve a similar purpose. The wedges serve to hold the ends of the box tight in the grooves in the sides, and also to keep the strain off the bolts.

### AN IMPROVED GATE HINGE.

The accompanying illustration represents a simple form of gate hinge, which has been patented by Mr. Peter C. Zimmerman, of Harrisburg, Pa. (lock box No. 49). The hinge is made in two sections, the section carried by the gate having two downwardly extending pintles, about which there are concentric flanges, each connected to one of the pintles by a projection, and each of the flanges having an opening on the side



ZIMMERMAN'S GATE HINGE.

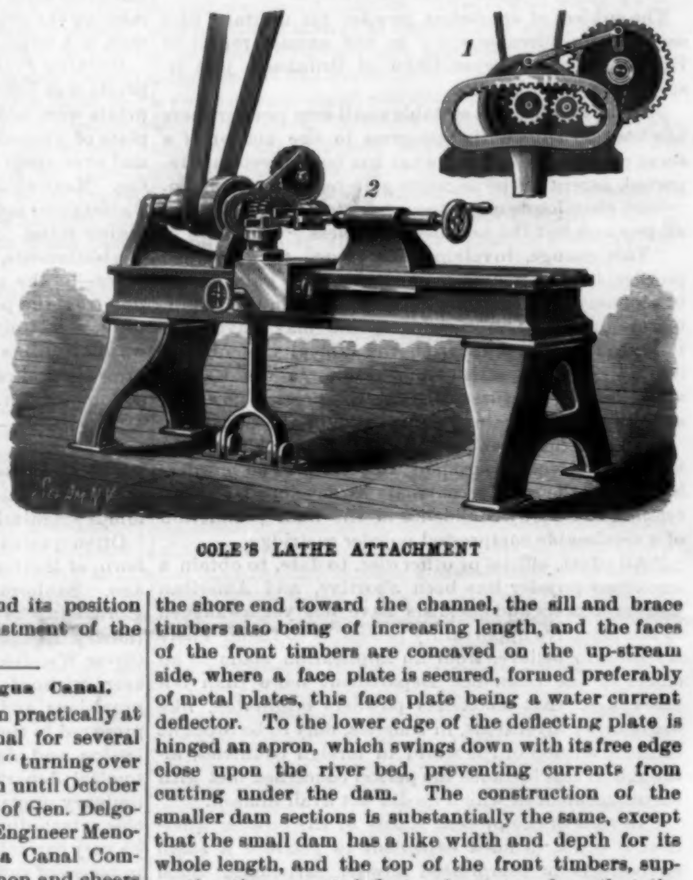
toward the post to which the gate is hinged. Between the pintles there is also a recess, centrally in which is a downwardly extending projection. The hinge post section of the hinge has end recesses, with upwardly extending end projections and a similar central projection. When the gate is closed the pintles rest within the recesses, and the central projection of the hinge post section rests in one of the recesses of the other section. As the gate is turned, in either direction, the pintle upon the side toward which the gate is swung will enter the corresponding recess in the hinge post section of the hinge, the projection on the same side of the latter section passing through the flange opening and into the annular space between the pintle and flange, while the opposite pintle on the gate section and projection on the post section swing apart.

### How Railways Increase Trade.

The following shows the great increase of trade in one branch of merchandise only between Mexico and the United States since the opening of railway communication between the two countries: In 1880 the value of American machinery imported into Mexico was $462,384. In 1887 the value of the same class of imports was $4,000,000.

### AN IMPROVED LATHE ATTACHMENT.

A lathe attachment to facilitate the turning of crosshead wrist pins and similar articles, the mechanism being simple and positive, and such as can be used in connection with any style of lathe, is illustrated herewith, and has been patented by Mr. Pliny F. Cole, of No. 1318 Water Street, Warren, Pa. Upon one side of the head stock is bolted a bracket from which two arms project upward, there being pivoted on the longer arm a spur wheel in which is a diametrical slot, and on the shorter arm a pinion meshing with the teeth of the spur gear. This pinion also meshes with a small spur wheel rigidly secured to the live spindle in front of the head stock, and in the inner end of the spindle is tightly inserted a live center upon which a pinion is loosely mounted. The latter pinion meshes with the teeth on the inner upper edge of a horizontal reciprocating link, as shown in Fig. 1, this link being guided in its lateral movement by an integral shank which passes downward between the shears of the lathe, where its lower end is pivoted in base blocks. This link is reciprocated through connecting rods, the wrist pin of one of which travels in the slot of the spur wheel pivoted on the longer arm of the bracket, while at the other end of this connecting rod is a longitudinal slot, where the two connecting rods are attached by a set screw and bolt. By varying the shape of the bracket and shortening or lengthening the connecting rods, the attachment may be readily applied to almost any form of lathe, and a long or short motion of the link obtained. In Fig. 2 the attachment is shown applied to a lathe in which the crosshead of an engine is secured, and a cutting tool is in contact with the pin of the crosshead. The crosshead is clamped to the pinion loosely mounted upon the center, and as this pinion is given a rotary reciprocating movement by the link, a similar motion is imparted to the crosshead, whereby the cutting tool is made to travel over more than half the circumference of the pin, so that when the crosshead is reversed the pin will be finished perfectly round. The loose pinion is so secured upon the live center that it may be readily removed from its place in the link and its position changed as may be desired in the adjustment of the work.




COLE'S LATHE ATTACHMENT

### Breaking Ground for the Nicaragua Canal.

The engineers and surveyors have been practically at work on the route of the Nicaragua Canal for several months, but the formality of the official "turning over the first sod" was not gone through with until October 22, when it took place in the presence of Gen. Delgodillo and staff, of Nicaragua, and Chief Engineer Menocal and staff, representing the Nicaragua Canal Company. Then, amid the booming of cannon and cheers of crowds, 100 American picks were, at a given word, driven into the soil, the shovels and the wheelbarrows following, the crowd afterward with a great rush taking the picks, shovels, and wheelbarrows from the laborers, and all insisting on digging at least a shovelful each, in hearty recognition of the importance of the event.

### Straw vs. Twine.

Early last spring the Illinois State Grange, through its executive committee, and seeking relief from the extortions of the twine trust, offered ten thousand dollars for a successful and practical machine or attachment to bind grain with straw.

For the information of the general public the following report is submitted by the executive committee:

We received applications, from persons wishing to compete for this prize, from every State and Territory in the Union, also from Canada and Scotland. The committee met August 20, and for three days carefully looked over and minutely examined the models, drawings, and specifications then submitted by forty inventors, many of the models showing much thought and inventive genius. July 8 had been intended as a day of field trial of straw binders, under this offer, but at this time not a single machine was ready for field work, and only one working model of full size. However, as letters and applications continued to arrive daily, on this important invention, the August meeting was adjourned without action, and a final meeting was held, October 29 and 30, when the committee decided that the full sized model above mentioned filled the bill, under the offer, and accordingly tendered the ten thousand dollars. The inventor, however, declined to deed his straw-binding device to the State Grange for this amount of money, having had much larger offers for his machine and its patents. We have seen this machine bind grain, and it does the work much finer and better than can be done with straw bands by hand. It has an extra attachment for short straw or grain, that can be set in motion by the foot of the driver. This binder seems perfect in all its parts, more simple and easier to operate than the twine binder. The knotter is not as delicate in construction, yet does not take up more room, and is not as heavy as the twine binders. We consider this a matter of great importance to all grain-raising farmers, for they will not hereafter be subject to the trusts and combines of the twine men, having plenty of binding material right at hand on the farm.

### AN IMPROVED PORTABLE DAM.

A sectional wing and portable dam, for changing currents, making channels, washing out sand bars, supporting and building up caving banks in rivers, etc., is shown in the accompanying illustration, and has been patented by Mr. G. H. Lummer, of Cairo, Ill. Fig. 1 shows the main portable dam and Fig. 2 one of the smaller dam sections, the other figures illustrating some of the uses of these dams. The main dam section consists of a series of base or sill timbers, to which vertical front timbers are secured, the latter being also connected with the sill timbers by braces, strong cleats making the joints of the structure firm. The front timbers are made gradually longer or deeper from the shore end toward the channel, the sill and brace timbers also being of increasing length, and the faces of the front timbers are concaved on the up-stream side, where a face plate is secured, formed preferably of metal plates, this face plate being a water current deflector. To the lower edge of the deflecting plate is hinged an apron, which swings down with its free edge close upon the river bed, preventing currents from cutting under the dam. The construction of the smaller dam sections is substantially the same, except that the small dam has a like width and depth for its whole length, and the top of the front timbers, supporting the current deflector, is convexed, so that the water currents will easily flow along it, and pass over it at high water. Fig. 3 shows the use of the two kinds of dam sections for changing the current of a stream, the main dam section being placed at a suitable angle across the river, and the auxiliary dams ranging from its two ends in such way that the current will be forcibly directed against the main dam, to be deflected thereby against the opposite bank and cut a new channel. In Fig. 4 two main dams are shown ex-


LUMMER'S PORTABLE DAM

tending from the opposite banks to small dam sections ranging centrally down stream, for deepening the channel, and in Fig. 5 a main dam is laid to direct the water currents against a sand bar. Fig. 6 shows a series of small dams set along a caving bank to protect it against the current, and hold the sedimentary deposits washed over and behind the dams.

### A Deep Gas Well at Niagara Falls.

The Buffalo *Courier* says: The test well of the Niagara Falls Natural Gas and Fuel Company, in the eastern part of the village, work upon which was begun July 16, had reached a few days ago a depth of 2,010 ft., without any great amount of gas having been found. A 5⅝ in. drill is used. At the start rock was found at a depth of 17 ft. Then the drill passed through 260 ft. of limestone and 65 ft. of slate and shale mixed. Then came about 35 ft. of what is known as the Tonawanda gas sand, but it was as hard as granite, and minus that porous formation in which gas deposits are found. The drill passed out of the Tonawanda sand into red rock, and went through over 700 ft. of it, into a layer of white slate about 200 ft. thick. Beneath this stratum of white slate the first sand was found, and there was about 75 ft. of it. Then came about 550 ft. more of white slate, beneath which a bed of red rock was struck, about 30 ft. in thickness. Next came a 50 ft. vein of silician rock, about the same as razor hones are made of. From this the drill went into a sort of a shale, for about 28 ft. This stratum is generally spoken of as the Utica shale. A 6 in. casing lines the hole for 300 ft. The fresh water was cased off at a depth of 180 ft., and salt water at 280 ft. At a depth of 190 ft. the first gas was struck, and at 192 ft. the second vein was found, while at a depth of 227 ft. the third vein of gas, together with fearfully strong black salt water, was found. From the three veins, gas enough to supply a couple of families could be obtained, but there was not sufficient volume to stop drilling. In the Utica shale, in which the drill is working, the hole is being sunk at the rate of 7 ft. an hour. So far the drill has been lowered 208 ft.

While gas in paying quantities is found in Tonawanda at a much less depth than that at which this well now is, the sand in which it is found there was really granite here. It is confidently expected that the gas in paying quantity will be found in the Trenton rock, which it is thought will be reached at about 2,400 ft. or perhaps a little deeper. A well at Thorold, Ont., about eight miles from here, was abandoned when the Trenton rock was reached, at a depth of 2,346 ft., but a lack of cable was given as a reason of the abandonment by the contractor. S. E. Humphrey and George Raymer are the men working at the well.

### An Ocean Lumber Raft.

The Fort Bragg Lumber Company, of San Francisco, is now about to try the Goldy boom, which has been in successful operation on the great lakes for about three years. According to this plan, says the *Pacific Lumberman*, a raft will be constructed of thirty-two pieces, each composed of seven sticks chained together and arranged in a semicircle, within which the logs that are to be towed will be placed. The Goldy boom will be supported by strong cross chains and fore and aft chains. By this means 1,500,000 feet of lumber can be brought down, or much more, if the circle is enlarged. The largest Joggins raft, constructed in the shape of a cigar, contained 3,500,000 feet of logs. If this method is successful, a large sawmill will be built on the water front, probably at Alameda. It will reduce the expense of shipment $3 or more a thousand feet.

### NEW SPANISH GUNS.

The Spanish government, determined to emancipate the country from its dependence upon foreign nations for its munitions of war, has of late years displayed great enterprise in the establishment of works for the building of war ships and cannon.

At Trubia the government has erected an immense concern for the production of heavy guns, and is now about to put in Siemens furnaces for the casting of high grade steel for new ordnance.

Among the guns lately turned out at Trubia are four which form part of the armament of the new Spanish steel cruiser Pelayo. Of these two are 49 ton 13 in. guns and two are 11 in. One of the 49 ton guns, shown in our engraving, was lately proved. The projectile used was of steel, weight 960 lb., fired with a charge of 440 lb. prismatic powder, which gave an initial velocity of about 2,000 ft. per second and a pressure near 20,000 lb. per square inch.

The guns are built on the Hontoria system. The penetrating power at short range is 32 in. of wrought iron. Length of gun about 40 ft.

NEW 49 TON GUN MADE AT TRUBIA, SPAIN.

### The Patent Office Examiners.

"Experts?" said a prominent official of the Patent Office recently. "Why, they are as thick as blackberries in the summer, and you can hardly enter a room in this building without meeting one or more. The work here is of such a technical character, embracing as it does the entire domain of inventive knowledge, that unless the men who decide upon the newness and practicability of the thousands of applications for patents, which they receive annually, did not thoroughly understand the state of the art, the court dockets would be crowded with the cases of litigious inventors."

Many of the examiners in the different divisions are men of deep learning. Especially is this true of the divisions where the class of applications are out of the usual run, and represent the greater inventions, such as the telephone and the recent advances in electric lighting. The experts who are called upon to pass upon the claims of Edison and others, in regard to new electrical devices, must of necessity be men who thoroughly understand the subject. With them it has been almost a life study, and there is no branch of the art that they are not thoroughly familiar with. They are constantly experimenting in the laboratory, investigating and demonstrating the practicability of the inventions which reach them, and possess a larger knowledge of that class of inventions than any persons living. It becomes a hobby with them, and, although the pay is small, the field for continuing their studies is so large that in their greed for scientific knowledge they sacrifice their pecuniary interests. Professor G. D. Seely, who is the examiner in electricity, knows more of the art, probably, than any man in the country. He has covered the field of electrical science thoroughly. His division is one of the most important in the office, and requires thorough expertness in dealing with the problems which it is called upon to decide.

At the head of the division of chemistry is Dr. Thomas Antisell. He is another expert in his particular line. Several years ago the office established a laboratory, provided with suitable chemical and physical apparatus, such as balances, batteries, filter pumps, microscopes, spectroscopes, platinum ware, gas assaying and melting and other furnaces to enable the examiners to conduct such experiments as they saw proper in passing upon the applications of inventors. Whenever it is necessary the office furnishes heat, power, light, electricity, and chemicals, and there is hardly a day but what some examiner is busy in the laboratory.

But the experts of this office are by no means confined to the divisions of electricity and chemistry. Every branch of science is treated of here, and the examiner must, of necessity, to be competent, be thoroughly familiar with their subjects.

The inventive faculties of the country seem to run in shoals, and just at present the subject of naval projectiles is receiving a great deal of attention at their hands. This requires that the man who passes upon their claims should know his business thoroughly, and he does.

Mr. P. B. Pierce, who has charge of the sewing machine division, is another man who can be considered an expert. He knows more about sewing machines than any man in the country, and has made the subject a life study.

And so it is throughout the office. Every examiner is an expert in his particular line, and some of their places would be exceedingly difficult to fill. The pay of these men is entirely disproportionate to the invaluable services they render. Every one of them could make a great deal more out of the office as an attorney, but they seldom leave. Why this is, nobody seems to know, unless it is that the work is congenial, and they are so wrapped up in it as to be willing to sacrifice their other interests for the sake of the opportunity for scientific researches which their position so abundantly gives them.—*Washington Post.*

### The History of a Star.

One of the strangest discoveries made by Sir William Herschel was that of "fire mist" in the heavens. With his giant telescopes he could discern, besides unknown planets, stars, and nebulæ, certain faintly luminous spots in the sky caused, apparently, by the existence of scattered nebulous matter. This mysterious appearance seems now, under Mr. Lockyer's new meteoritic theory of the constitution of the celestial bodies, to range itself quite naturally in the regular sequence of phenomena by which we are able to trace the life history of the universe. But it is only fair to recall the fact that Herschel himself assigned to the nebulous mists of celestial space a place in the development of the material creation precisely like that which they occupy in the new hypothesis. Only, Herschel dealt with a supposed self-luminous substance of a highly attenuated nature instead of with swarms of clashing meteors or meteoritic dust. According to either theory, however, we find in those glimmering clouds of space one of the earliest forms in which the great celestial bodies make their appearance—forms no more resembling the blazing suns or the encrusted planets ultimately to be developed out of them than an acorn resembles an oak, but representing a stage of creation as far transcending in remoteness of time the first geological period of a body like the earth as that surpasses in the ratio of antiquity the records of Adam's career in Eden.

In the *Nineteenth Century* for November, Mr. Lockyer has published, under the caption adopted for this article, what is perhaps the best popular statement he has yet made of his meteoritic theory. It is a theory that has not been accepted by all astronomers, and in some of its aspects has been sharply contested, but it supplies an orderly account of phenomena that have not been so well linked together in any other way, and in many respects it is a decided advance upon the old nebular theory of our origin.

The earth is journeying through space in two ways. First it is circling around the sun, going more than a million and a half of miles in a day. But the sun itself is in motion, flying at the least half a million miles in a day in a direction not quite at right angles to that in which the earth travels, and the earth has to accompany the sun. In consequence our planet is really gyrating through space in great spiral sweeps around the sun, and so advances from the southern toward the northern part of the firmament. If the atmosphere were renewed every day, we should be constantly breathing the air of new regions. And, in fact, there is one way in which we do come in contact with the contents of the unknown parts of space into which we are hourly advancing, although we may be unconscious of it. That is by the fall of meteoritic matter upon the earth. Taking no account of the ether, space is no more absolutely empty than the air of a room is perfectly clear of impurities. As the air is filled with floating dust, so interstellar space abounds with dust of a different kind, the scraps of the unfinished universe. As the earth speeds along, this dust of space continually falls upon it, the larger particles catching fire from friction as they rush into the atmosphere, and thus appearing as falling stars or meteors; the finer grades simply sifting down through the air, and making their presence visible on the snows of mountain peaks and in the ooze of the ocean's bottom. Occasionally a meteorite more massive than its fellows survives the fiery passage through the atmosphere, and falls a blazing mass upon the earth.

It was a striking idea of Mr. Lockyer's to take one of these messengers from outer space and submit it to the analyzing powers of the spectroscope. Why might not this tiny inhabitant of the heavens fallen upon the earth have some secrets to reveal concerning the constitution of the other bodies from the midst of which it came? Upon the result of this experiment Mr. Lockyer founded his theory. The result of the experiment in brief was that when a meteorite was reduced to dust, and that dust was submitted in the laboratory to a low temperature, and the light emitted by it was examined with the spectroscope, its spectrum was found to be identical with that given by the faintly glowing nebulæ seen in the heavens. With higher temperatures the meteoritic matter gave spectra agreeing with those of many of the stars. The resulting theory is that the nebulæ are clouds of meteorites or meteoritic dust heated, and so caused to glow, by their mutual collisions, and that many stars are not globes of gaseous matter like our sun, but meteoritic swarms so compacted that a fierce light is caused to blaze from them by the constant and violent clashing of the meteorites. With this idea in mind we can then range the nebulæ and the stars into a continuous series, according to the degree of density that the meteoritic swarms have attained, and the consequent intensity with which heat and light are developed in them. Their varying spectra give a clew to their condition in these respects.

Beginning as far back as we can go, we find that the wonderful power of photography takes us a step beyond the utmost reach of the most powerful telescopes. There are nebulous objects in the heavens fainter even than those mysterious clouds of fire mist that the enormous reflectors of Herschel revealed to his astonished eyes. The forms of nebulæ that the most gigantic telescopes cannot reveal to the eye have already impressed themselves upon photographic plates exposed to their strange radiations. The reason they can thus be discovered even when too faint to make any impression upon the eye is because the photographic plate possesses the property of accumulating the effect of radiations falling upon it, which the human retina cannot do. The longer the plate is exposed, the more it detects. According to the theory we are considering, these photographic nebulæ must be regarded as swarms whose component meteorites are so scattered that collisions are comparatively rare, and the consequent radiation is so slight as to be unable to impress the eye with a sense of light.

Next come the nebulous mists of Herschel, in which the condensation has progressed a step further and the meteorites are firing up with the heat of more frequent and more violent collision; then the various classes of brighter nebulæ, wherein the condensing process has become more pronounced; next star-like swarms so compacted that as seen across the enormous spaces separating them from us they cannot, by the eye alone, be distinguished from stars resembling the sun. The stars divide themselves into several classes, each successive class being characterized by a spectrum which indicates that it is denser and hotter than the preceding class, until we reach the hottest stars of all, in which the meteorites, rushing and swirling and grinding ever closer and closer in the resistless embrace of gravitation, have, in consequence of the resulting heat, been reduced to vapor

It is believed that our sun has not only reached but even passed this stage, for, as we shall see, there is a downward as well as an upward course in this strange history. Following the hot and gaseous stars, we find another series in which the evidence is of decreasing energy and of gradual extinction. The heat is radiated away into space, the outside of the star cools first, a cloud-like shell surrounds it and slowly extinguishes its radiation, the whole character of its spectrum changes, it glares with a red light, showing the absorptive influence of the gases that are, so to speak, smothering it, and finally it shines no longer. According to Mr. Lockyer the fate that awaits our sun (and it has already progressed half way down the shady side of solar existence) is to be put out by an excess of carbon vapors in its atmosphere. But after a star has thus been extinguished, the process of cooling and condensing goes on within its core until it is changed to a solid globe of metals and minerals like the earth and the moon. Such is the life of a star.

The stars we have been describing exhibit a regular sequence of events throughout their history. They are the orderly and well-regulated citizens of the celestial empire. But space contains erratic stars which cannot be classed with our own benignant, well-mannered, and still sufficiently warm if rapidly aging sun. They are the variable stars, which in many cases increase and decrease enormously in brightness in more or less regular periods, and the so-called new stars which suddenly blaze out in the heavens and then slowly fade from sight, never to appear again. The meteoritic theory undertakes to account for these irregular varieties of stars also. According to Mr. Lockyer's idea, variable stars are formed by two swarms of meteorites, one revolving close around the other in an elliptic orbit, so that when their centers are nearest together, more meteorites come into collision than when they are further apart. The outburst of a new star he supposes is caused by the meeting of two elongated swarms in space, like railroad trains coming into collision at the crossing of two roads. At the point of meeting there will be a dazzling display of light owing to the crashing together of the meteorites, and this will last as long as the swarms are passing their common meeting point, after which the "star" will disappear.

It has long been known that comets are condensed swarms of meteors, and Mr. Lockyer, of course, includes them in his theory. The most mysterious thing about a comet is its tail, which is evidently composed of something that the sun drives off from the body of the comet as it approaches. As the comet swings around, the tail always keeps on the side away from the sun. It is significant that comets which have come permanently under the government of the sun's attraction, and continue to revolve around it in regular periods, gradually lose their tails, the apparent reason being that the material which the sun rejects finally becomes eliminated from them. According to the Lockyer theory, the tails of comets are probably composed largely of gases existing in meteorites, and which can be driven out by comparatively slight heating. This gaseous matter is repelled by the radiant energy of the sun, which is the very life blood of the solar body, since it also prevents the collection of absorbing vapors in its atmosphere. When the energy begins to fail, the permanent gases begin to close in upon the doomed star, and its final extinction is only a matter of time.

How different is the aspect in which such studies as these present the universe to our view from that in which it appeared to men in former times! Then the celestial bodies were looked upon as something differing in their very essence from terrestrial phenomena. A complete distinction was imagined between the heavens and the earth. But now we see that they are continuous—one in composition, identical in origin, united in destiny. We are in touch with the whole creation. Stars have a beginning, a development, a noontide of life and energy, a period of decline, and an ending that we may call their death, like all other things; and, thanks to the telescope, the spectroscope, and the photographic camera, there is not a stage in their marvelous history in which we cannot recognize the operation of Nature's most familiar laws transforming the common substances that compose the earth into all the wonder works of the heavens.—*Garret P. Serviss, in the New York Sun.*

### Professor Gale the Discoverer of Electric Telegraphy?

In a cabinet in the Western Union telegraph office in this city may be seen the crude apparatus, his own handiwork, with which Samuel Finley Breese Morse made the first practical demonstration of his conception of recording signals by the action of electro-magnetism at a distance, the distance being not greater than across a large room. When the length of the wire was increased, the action was so enfeebled as to render the apparatus inoperative. Leonard A. Gale afterward suggested to Morse to wind his electro-magnet with a fine wire (of high resistance) and thus adapt it to the purpose for which it was intended, viz., the transmission of signals to great distances.

But suppose Morse did construct a telegraph consisting of a stylus moved by electro-magnetism, which was exhibited in actual operation for days or weeks or months, was it a successful invention? Would the Western Union Telegraph Company purchase or use such a machine now? Did it not lack an essential ingredient which was necessary to its commercial usefulness? Did he go any further in principle, if he did in degree, than did Henry in 1831? It would seem that he was following a wrong principle, the principle of small resistance in his electro-magnet and a strong current of electricity; and that the great discovery in the art of telegraphy was that of employing high resistance in the electro-magnet, with a small core, and a corresponding diminution in the strength of the current required. This was accomplished by Gale, in his filamental, thread-like magnet wire, rendered practicable by the placing of the battery elements in series. With such a battery, the slender filamentary magnet wire, attenuated to the last degree of fineness, may be made to do its work through a circuit of hundreds of miles with a small expenditure of electric force. This was really the grand discovery in the art of electric telegraphy, without which it could not have become a practical art.

Of course, the form into which the wire is coiled may be varied at pleasure; it may be wound upon a cylinder or a horseshoe, or it may surround a galvanometer needle. All these forms are old. The principal and great thing is the attenuated conductor, and its use in connection with a series of many cells. There may be a preference in the metal from which the attenuated conductor is made. Practice will evolve all these collateral advantages.

We think we are not mistaken in saying that, but for this discovery, electric telegraphy never would have become a fact. We may suppose it to have been the discovery of Professor Gale. It may not have been so; it may have been the discovery of Professor Henry. But whoever discovered it, it is undoubtedly *the* great discovery in the art of communicating intelligence to a distance by electricity. We have given a more detailed account of it, in order to illustrate what we mean when we raise the question whether the claimed invention of Morse was ever successful. He may have made a telegraph that would record arbitrary signs, capable of being interpreted; but was it a success, or was it a failure? Did it ever go into use? What was the object of all the experiments made by him and others? Was it not to make an electric telegraph that could be successfully used by the public, and have a commercial value? Did he succeed in making such a telegraph or in finding out, until Gale told him, the principle upon which it could be made? We do not so read the evidence. In view of the most recent decisions, Gale, and not Morse, is the man to whom we are indebted for the art of transmitting telegraphic signals to a sufficient distance to be of any practical utility.—*The Electrical Engineer.*

A natural gas field which was lately discovered a few miles east of Welland, Ont., is being developed with energy by the company of which Mr. Eugene Coste is manager. The second well, which was completed a few days ago, has been torpedoed with 40 quarts of nitroglycerine, and the result, after careful measurement by Mr. Coste, shows a production of over 500,000 ft. of gas per day. The closed or rock pressure of the two wells now completed is 475 pounds to the square inch, which would allow the gas to be piped 100 miles.

## Correspondence.

*To the Editor of the Scientific American.*

Observing that you quote with approval, in your issue of November 2, the utterance on the part of the International Marine Conference that "The term 'starboard your helm' shall mean that the wheel or tiller, rudder, and bow shall go to the starboard," etc., it occurs to me to be surprised that you do not comment upon the confusion of ideas which, it seems to me, is likely to be caused by the words "wheel, tiller, rudder, and bow shall go." Except in the construction of some steam vessels, where the tiller is placed abaft the rudder post, so that it goes as the rudder does, the rudder and the tiller manifestly cannot go in the same direction, and to the helmsman of a sailing vessel which is steered by means of a tiller, "Port your helm!" means that the tiller goes to port and that the rudder and the bow go to starboard. Strict adherence to the letter of this article is therefore impossible, and if an article or rule cannot be so adhered to, it is dangerous! If no attempt at strict definition was made, and "starboard" was taken to mean the direction of the bow, each steersman could settle for himself the side to which he shall put the "wheel or tiller or the rudder." So long as the ship heads rightly, what matter how she gets there? A. S. G.

[We only quoted the terms as they were given in a proposal before the conference. As the steering rules are to be passed upon for amendment, the absurd terms will no doubt be discussed and the word *tiller* placed in its proper relation.—ED.]

*To the Editor of the Scientific American:*

I have read your account of the doings of the International Marine Conference, and am reminded of some early experience. When a boy and "in swimming" in Lake Erie, I have many times put my head under the water and distinctly heard the pounding of the paddles of sidewheel steamboats long before the boat was in sight, and could easily tell from which direction it was coming.

Now we know that water transmits sound with great rapidity as compared with air, and sounds so transmitted would not be liable to interference by storms such as the air offers; and it seems to me that if a box containing a diaphragm similar to that of a mechanical telephone, with sufficient projection to protect the diaphragm from disturbance by the motion of the water, was placed deep in the water, say one at the bow, one at the stern, and one at each side, and a wire attached to each diaphragm, or, perhaps, even a speaking tube, and all leading to the pilot house, a listener could distinctly hear such sounds as would be made by the strokes of a paddle wheel or the roar of a screw propeller, and could determine the direction from which they came. Exploding bombs dropped into the water would surely give such shocks as could be heard many miles away. Perhaps the scheme is very old, and has long ago been determined to be impracticable. Please give me your opinion of it. R. W.

[The transmission of sounds through water has been long known, and through the earth has been in practical use, since our early history, by the Indians, who trace footsteps by placing the ear upon the surface of the ground. Its application on board of a moving steamer, or even sailing vessel, would probably be impracticable, from the presence of local noise and tremor.—ED.]

### Rope Driving.*

BY LOUIS L. SEYMOUR, PLYMOUTH, MASS.

The difficulty heretofore experienced in transmitting large powers from a central station to a number of buildings lies chiefly in the fact that shafting must be run at various angles with the main shaft of the prime mover, necessitating quarter turns in belting, bevel gears, or other similar arrangement, usually placed in subways, where adjustment is not easy and the attention given is only casual.

Now that the transmission of large amounts of power by manila rope is carried on successfully in many places, the points which most interest manufacturers are:

What is the first cost of the transmitting apparatus?

How long do ropes last?

How far will they carry power without serious loss in the transmitting apparatus?

Assuming the Corliss engine at the Nourse Mills to be a fair sample of direct belt transmission, we find that a belt flywheel thirty feet in diameter and 110 inch face is used to transmit a thousand horse power at a speed of fifty-seven revolutions per minute. Eighteen 1¾ inch ropes would be required to transmit the same power on a flywheel forty-six inches wide, while a rope wheel 110 inches in width would carry forty-four ropes, transmitting 2,400 horse power.

In a rope drive recently planned by the author, two hundred horse power is conveyed from a ten foot rope sheave on a jack shaft running 122 revolutions per minute, to a driven sheave, sixty inches diameter, by five wraps of 1¾ inch rope, each 178 feet long, requiring in all 930 feet of rope weighing 815 pounds and costing $130.40.

To transmit the same power, a 27 inch double leather belt would be employed, at a cost of $725 or nearly five and a half times as much. Taking Lockwood & Green's estimate of rope sheaves at the Washington Mills, their cost was found to be $5,696.10, while for belt pulleys the cost would have been $6,846.75, leaving a difference of $1,150.65 in favor of rope sheaves.

The conditions necessary to a successful rope transmission are properly grooved iron sheaves and a rope of uniform diameter.

According to Unwin, the coefficient of friction for a rope on a metal pulley=28, and with this form of groove the normal pressure between the rope and the sides of the groove is greater than the force pressing the rope into the groove in the ratio of the cosecant of 45° : 1, hence the coefficient becomes 0·7.

A usual mistake in the form of groove consists in making it round bottomed and slightly smaller than the diameter of the rope.

This form of groove has never failed to wear out a maximum amount of rope in a minimum amount of time, and its use is largely responsible for numerous failures of ropes to drive satisfactorily.

Cotton ropes are much used in foreign countries for driving purposes, and when treated weekly with a compound of pitch, wax, and lampblack work very successfully.

Probably the most satisfactory rope for driving purposes is composed of manila whose fibers have been treated with an emulsion in the process of manufacture which effectually prevents the internal wear and lessens the friction of the fibers upon themselves when passing around a sheave. The emulsion also acts as a lubricant between the rope and the groove in which it runs. Such a rope needs no after application to make it pliable, and after a few months' usage becomes glazed on its bearing surface, when all external wear apparently ceases.

Ropes having four strands around a central core are used in sizes of 1¼ inch diameter and upward, those of three strands without a core being used in smaller sizes for facility in splicing.

Proper rope driving is of so recent date in this country that no reliable data are available regarding its life.

Judging from the appearance of some ropes which have run over three and half years, after transmitting more than twice their rated capacity, the life of a rope would be not less than seven years.

In earlier drives much difficulty was encountered in the selection of the proper splice. Both the ordinary short and long splices caused a jerky motion in the rope, and they were finally discarded for what is now known as the English splice.

From experiments recently made at the Watertown arsenal the breaking strain of manila transmission rope is 9,500 pounds per square inch of section and about 7,000 pounds at the splice.

Taking the case of a 1¾ inch rope traveling 5,000 feet per minute, the initial tension necessary in belt driving is entirely absent. Its weight being only ⅞ of a pound per lineal foot, the tension due to its weight is very small. The tension due to the power transmitted is 330 pounds, and that due to centrifugal force is 216 pounds, making a total of less than 550 pounds, or 3.4 per cent of its strength, at the weakest point, the splice.

The centrifugal force, when passing around a sheave at such a rate of speed, is so great that the tendency to hug the sheave is entirely overcome and the "loss of work caused in pulling the rope out of the groove," mentioned by some writers adverse to rope driving, is seen obviously not to exist.

Where a number of ropes are used side by side for a single drive, they should be in one piece, wrapped as many times around the sheaves as may be necessary to transmit the power required, with a single take-up sheave, when the pulleys are of the same diameter. When the diameters vary greatly, the double take-up arrangement should be used.

Such a warp has but one splice, and the slack caused by the stretch of the rope can be taken up without resplicing, and the loss of power when several ropes of varying diameters are run independently on the same sheaves is avoided.

For long out-door transmissions the movable take-up sheave (usually set in a frame sliding in ways) has a weight attached to its carriage, which takes up the slack and gives it out, alternately, in dry and moist weather.

Where the driving and driven pulleys are of the same diameter, a wrap is not a necessity, as each rope, no matter what its size, drives its share.

The length of span for long drives should not exceed 150 feet, ordinarily, and when this rule is observed, power may be easily transferred two or three thousand feet with but slight loss.

The take-up sheave is placed in a frame sliding in ways, to which is attached a weight of 400 pounds, on a wire rope passing over a small pulley. This puts a strain of 200 pounds per lay of the rope or 35 pounds less than the actual working strain when transmitting 100 horse power. The friction of this transmission, at 3,500 feet velocity per minute, is 4.94 horse power, and it is difficult to see how any other form of transmission could be applied, with so small loss from friction, even at a much greater first cost.

In conclusion, the advantages of manila rope transmission are:

Small first cost.

Slight attention required.

Close alignment unnecessary.

Transmission of large amount of power in small space.

Adaptability to transmission at any angle, in any direction, and at any ordinary distance, without serious loss from friction.

* Abstract of a paper read before the semi-annual meeting of the New England Cotton Manufacturers' Association, at Boston, October 30, 1889.

### The Edinburgh Electrical Exhibition of 1890.

In its general appearance, says *Engineering*, the building somewhat resembles the structures now associated with exhibitions, and yet there are one or two distinctive features indicated in the perspective view. The characteristics of Moorish design are borrowed to give it a light and attractive decorative appearance, particularly in the case of two towers, which form a prominent feature in the elevation, as they flank the principal entrances, and in the series of domes with turrets at either end of the building. The Union Canal passes between the public road and the exhibition grounds, and the main building is built parallel with the canal. From the main road a steel girder bridge carries the entrance way over the canal, and this way, which, like the bridge, is covered in with a light awning, diverges in circular lines in two directions to the main entrances. The main building, which is 170 ft. from the canal, is 700 ft. long and 200 ft. in width. Running across the center of the building at the entrance is the principal court, with a high arched roof, and on either side of the ceremonial entrance are to be reception rooms. The general courts right and left of this principal one are 50 ft. wide. The total floor area is 177,000 square feet. There is to be a large concert hall 200 ft. long and 100 ft. wide, which will have the distinct advantage of being separated from the general exhibition courts. There will, of course, be the usual dining and refreshment saloons. At the west end of the building there is to be a promenade with veranda, from which a fine view of the grounds will be had. The suburban railway intersects the grounds, and is to be bridged by a strong timber structure 30 ft. in width. On the side of the railway opposite to the main building is to be the general machinery hall, 700 ft. long and 150 ft. wide, having a floor area of 99,600 square feet, and in close proximity there will be a boiler shed. Throughout the buildings there will be the usual structures. When the plans were before the Dean of Guild Court at Edinburgh, the Lord Dean of Guild complimented the civil engineer and stated that he thought the plans were admirable. It may be added that the executive are trying to arrange that several typical American locomotives will be exhibited alongside engines of British build, and that if possible several runs will be made between Edinburgh and London with these locomotives, to test the relative efficiency of British and American engines on English railroads. The results will doubtless be very interesting. This shows the desire of the executive to produce something distinctly new. Mr. W. A. Bryson, a member of the Institute of Electrical Engineers, has been appointed engineer and electrician, and his connection with the Glasgow and other exhibitions gives a guarantee that, so far as his efforts are concerned, the exhibition will be a success. Arrangements have been made for forwarding to Edinburgh exhibits at the Paris exposition from Russia, Italy, Austria, China, and the East Indies.

### Elevators—Liability—Carriers.

An important decision was recently rendered by the Supreme Court of California in the case of Treadwell vs. Whittier et al. The case arose upon an action to recover damages for personal injuries caused by the falling of an elevator in which the plaintiff was riding in the defendants' store building. The Supreme Court held, in affirming the judgment of the trial court, that the defendants, in operating their elevator, were carriers of passengers, and the same responsibilities as to care and diligence rested on them as on carriers of passengers by stage coach or railway; that, while they were not insurers or warrantors of the safety of passengers to the same extent as common carriers of goods, *i. e.*, insurers against all injuries except by the act of God or by public enemies, still they were liable for the slightest neglect and were held to extraordinary diligence and care; that the manufacturer of the elevator was defendants' agent or servant in its construction, and that they were responsible for any want of care of the maker or builder; and that, like common carriers of passengers, they must keep pace with science, art, and modern improvements in supplying safe obtainable vehicles, machinery, and appliances for their use, and must use every precaution which human skill and foresight can suggest.—*Bradstreet's*.

THE BOSTON MARITIME EXHIBITION.

The lighthouses of the coast, with their great lenses, clockwork oil feeds for lamps, and revolving curtains or turrets for flash lights, are objects familiar to many. So are life-saving stations, life boats, life rafts, mortars, rockets, life lines. Many have gone up into the towers of the Weather Bureau's signal stations, visited navy yards and ship yards. Few, however, have seen them all, while many have seen them without understanding.

In the big Maritime Exhibition at Boston, in the Mechanics' building, are grouped together the most interesting objects of this kind, together with all the new apparatus designed for use on sea or coast, the various and curious furnishings for ships of war, mercantile and fishing fleets, guns, torpedoes, buoys, instruments for surveying the sea and sounding its depths, for the study of live forms of the ocean as it is carried on in the curious craft of the Fish Commission, and much else pertaining to seafaring life or looking to the governance and protection of sea industries and the mariners engaged in them.

Entering the main hall, the first object that attracts the eye is a graceful schooner yacht in full figure. (See main view, first page). It is the Quickstep, built by the famous Burgess, and, like all his boats, having a noble sheer and lines so delicately drawn, so true, it seems as though they would scarce disturb the play of ripples upon a summer's sea. The pitch pine spars tower aloft and lean rakishly backward, a glistening main boom shows its length over the stern, and an enormous jib boom stretches far outward over the bow. Her dimensions are: Length over all, 78 ft.; water line, 58 ft.; beam, 14 ft.; height of masts, 84 ft. The 7th Regiment band, N. G. S. N. Y., plays from her main deck. A very proper exhibit is this noble craft, nor too prominent, either, seeing it represents the only class of Yankee craft that has of late borne our colors to the fore. To regain a maritime ascendency, or, at least, to make an effort in that direction, is one of the purposes of the present exhibition.

The models of the Fish Commission's steamers Fishhawk and Albatross (see upper left hand corner of front page) are about seven feet long, thus making it possible to study their details—the tanks for fish and spawn, the drag nets for catching shell fish, crustacea, sponges, gulf weed, and the like, the nets for big and little fish, microscopes for studying minute sea forms, self-registering thermometers and hydrometers. These steamers have floating anchors, raft-like looking objects, which, drifting much slower than a vessel, hold her head up to windward when her zoological commanders would lie by in a seaway for observation and study.

From right to left, in the great hall, many large objects attract the eye. Now it is a barbarian proa of the Ladrone Islands or an Arab dhow; now a Chinese junk or a Genoese fisher bark, xebec or polacre, with lateen sails and bamboo booms. You can study the progress of sail making and setting, from the earliest times; the ancient square-sail cut, the rise and progress of the fore and aft rig. Here is the North Sea fisherman and our own banker, here a faithful image of the lugger, the Snow, and so on.

To the American ambitious, like the projectors of the exhibition, to see our flag once more taking its rightful place in deep water, the more modern craft, handiwork of American builders, have a peculiar interest. He will find exact models of the new cruisers, of ships, barks, brigs, schooners, steamships, and steamboats. He will find a section of a rope of 120 fathoms of the largest size hempen hawser known (see illustration). It was made at the rope walk of the Charlestown navy yard, and is 25 inches in circumference, weighs 15,000 pounds, and will resist a strain of 212·58 tons.

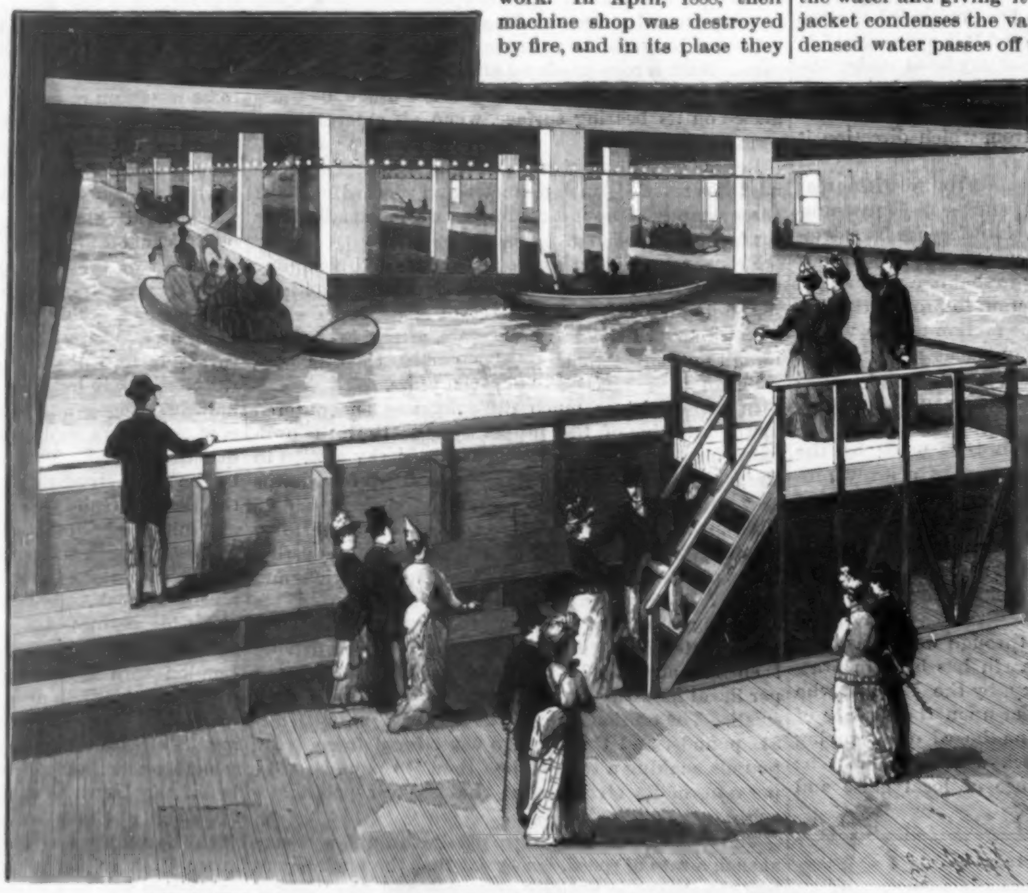
He may also see how ships are constructed, the great marine engines for steamers in their various stages of construction, and view the ponderous machinery used. A notable exhibit of this kind is furnished by the famous Atlantic Works of East Boston. Turning to the left as you enter the building there is an inclosure where, arranged side by side, are photographs, some of them six feet across, being exact representations of the interior of the Atlantic Works ship yard and its various workshops. A view of the interior of the main shop and a

HAWSER, 25 INCHES IN CIRCUMFERENCE.

general view of the yard and shops of these works are shown at the bottom of the first page.

This corporation, organized in 1853, has an extensive plant, on deep water, directly opposite the Charlestown na y ard. Their specialty is marine work, and they have excellent facilities for handling this class of work. In April, 1888, their machine shop was destroyed by fire, and in its place they have erected a model shop, consisting of two brick buildings, 90 feet by 200 feet and 70 feet by 87 feet respectively, which are fitted with the best of tools and appliances, including a Sellers traveling crane of 15 tons capacity, shown in the right hand cut. The forge shop, boiler shop, and pattern shop occupy separate buildings. Upon the end of the wharf is a pair of shears, made of plate iron, 120 feet in height, and capable of lifting 150 tons (see cut).

During the war of the rebellion, this company executed a large amount of work for the government, employing about 800 men continuously, and made an excellent record for themselves. They have since built several sloops-of-war and revenue cutters, but the great increase in facilities for building steamships, etc., in Philadelphia, Wilmington, Chester, etc., has, of course, interfered with successful competition in this line of work by New England concerns. The Atlantic Works have turned out a large number of ferry boats, tow boats, steam yachts, etc., and have a reputation for first-class work. They also have done a very large amount of repair work upon hulls and machinery of foreign and domestic steamships.



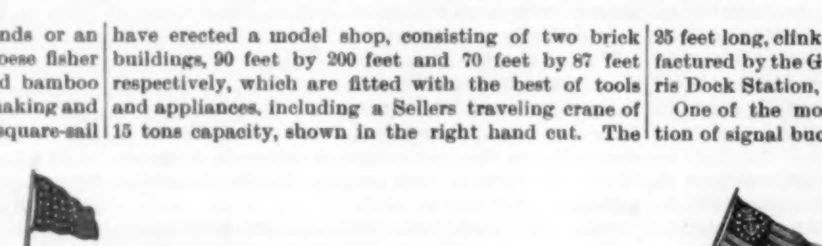
MINIATURE CANAL AT THE BOSTON MARITIME EXHIBITION.

Pure drinking water for those who go to sea is a necessity. On land, especially in crowded cities, how to obtain it has come to be one of the most important problems of the day. Organic matter and other impurities are discovered by analysis in the drinking water furnished to all cities. A new process has been discovered of purifying water. It is shown here in the machinery section, by a working model of what is called the cold blast water still (see front page). Its most striking feature is the simplicity of its parts and the thoroughness with which it does its work. It is quite unlike other stills. With this (the Chase system) the water is clear as crystal, and its purity may be inferred from the following analysis: Oxygen gas, 33⅓ per cent; hydrogen, 66⅔; sulphate of potassa, .00; chloride of sodium, .00; carbonate of soda, .00; carbonate of lime, .00; carbonate of magnesia, .00; oxide of iron, .00; silica, .00; organic matter, .00 = absolute purity, 100.

The water is received in the bottom compartment, where is a steam coil for vaporizing. The steam rises into the top dome. Air is first admitted to central upright column, from there being drawn into the dome and mingling with the vapor, thus aerating the water and giving it life and sparkle. The water jacket condenses the vapor in the dome, and the condensed water passes off through the inclined tube into the reservoir or receiving tank. The impurities settle to the bottom. The still runs itself, and will purify any kind of water, salt or fresh; the capacity of the largest kind being sixty gallons per hour. This admirable still is made by the Cold Blast Still Company, Swett Street, near Albany, Boston, Mass.

In the basement of the exhibition building there is a canal, quadrilateral in shape, 565 feet long, 12 feet wide, and 6 feet deep. Over its smooth surface glide graceful gondolas, and an electrical launch darts hither and thither, while a naphtha launch, that triumph of Yankee cunning, circles round and round the course, a practical exhibit of the most economical and convenient of marine motors. It requires no engineer nor fireman nor handling of fuel, and gives off no smoke. You have but to strike a match, touch a lever, and you are off and spinning away. You touch the lever again and reverse the screw, and you stop. This launch is 25 feet long, clinker built, of 4 horse power. It is manufactured by the Gas Engine and Power Company, Morris Dock Station, near High Bridge, New York City.

One of the most interesting exhibits is the collection of signal buoys, including bell buoys, whistling, spar, and other varieties of buoys—a collection that is quite complete, and attracts a good deal of attention. It has been loaned by the government. Many varieties of canoes, sail boats, and row boats are also exhibited. In the main hall near the yacht Quickstep is a very interesting collection of photographs illustrative of the work connected with the Fish Commission.



NAPHTHA LAUNCH FOUR HORSE POWER.

The Navy Department exhibit an important collection of hemp and wire rope, the latter containing examples of wire rope that is now being manufactured by the government.

The Massachusetts Humane Society have an exhibit of various life-saving devices, such as a life boat mounted on a beach wagon of the usual type, motors for throwing the life lines, night signals, and other life-saving paraphernalia.

The attendance at the exhibition has been very satisfactory, and in conjunction with the Maritime Congress

recently held at Washington, bespeaks an increasing interest in maritime matters in this country that promises well for the future of shipping in this country.

### A MAMMOTH CACTUS.

The accompanying engraving, from *La Nature*, represents a specimen of a *Cereus* growing against the wall of a house at Antibes, in the Maritime Alps.

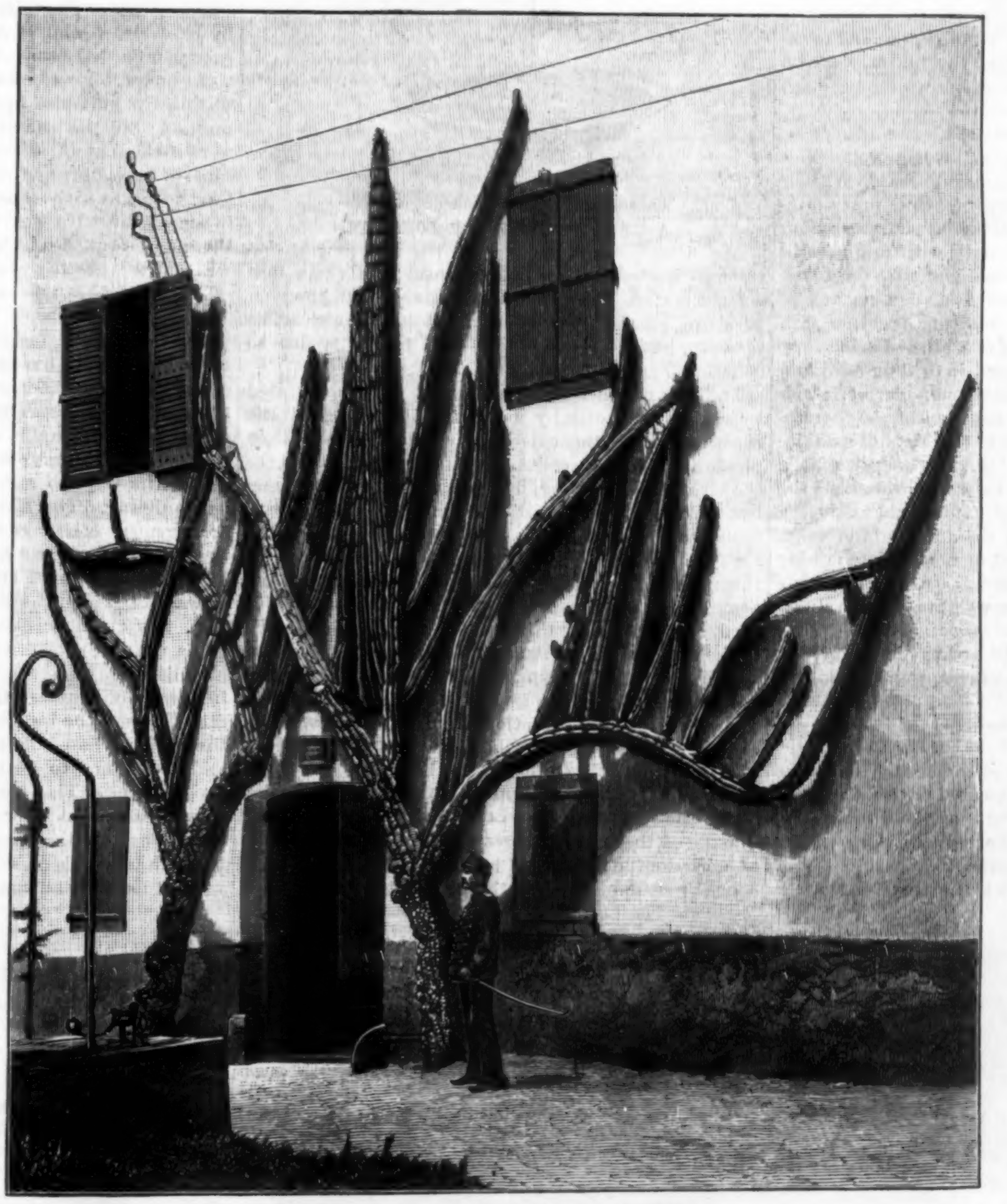
The species of this genus of the Cactaceæ, which is an extensive one, are remarkable for the singularity of their form and for the beauty of their flowers. While young, their stems are fleshy, but many of them become hard, and woody even, in the course of time, and vary much in form, those of some species being cylindrical, ribbed, and fluted, while those of others are angular or nearly square. Some grow erect, others creep along the ground or up trees, and send out roots from their sides. Some are unbranched, while others have numerous branches, and some are jointed. Most of them are armed with spines, which radiate from small cushion-like tufts placed at regular intervals along the ridges or angles of the stem. The tubes of their flowers are funnel-shaped, and usually armed with small spines.

The "suwarrow" or "saguaro" (*C. giganteus*) of the Mexicans is the largest and most striking species of the genus. It is a native of the hot, arid, and almost desert regions of New Mexico, extending from Sonora to Williams River, and found growing in rocky valleys and upon mountain sides, often springing out from mere crevices in the hard rock, and imparting a singular aspect to the scenery of the country, its tall stems with upright branches looking like telegraph poles for signaling from point to point of the rocky mountains. While young, the stems are of a globular form, but gradually become club-shaped, and ultimately almost cylindrical, and from 50 to 60 feet in height, with a diameter of about 2 feet at middle height and gradually tapering out upward and downward to 1 foot. They are most frequently unbranched, but some of the older plants have branches, which issue at right angles from the stem and then curve upward and grow parallel with it. The stems are regularly ribbed and fluted. The flowers are produced near the summit of the stems and branches, and are about 4 or 5 inches long by 3 or 4 in diameter, and have light cream-colored petals. The fruit is about 2 or 3 inches long, and, when ripe, is made into an excellent preserve by the Pimos and Papajos Indians. This plant is sometimes facetiously called the "Arizona shade tree."

*Cereus Thurberi* is commonly called pitahaya by the Mexicans, and this is the name by which it was known to the Aztecs. It grows in the Papajo Indian country, on the borders of Arizona and Sonora, to a height of 20 feet, and bears two crops a year. The fruit is better than that of the giant cactus, and is used for the same purposes.

*Cereus MacDonaldiæ* is one of the night-flowering kinds, and is very beautiful. Its flowers, when fully expanded, are as many as 14 inches in diameter, and have numerous radiating red and bright orange sepals and delicate white petals. The stems are cylindrical, creeping, and branched, not much thicker than the little finger, and having here and there small swellings with a spine in the center. It is a native of Honduras.

The most common night-blooming cereus is the *C. grandiflora*, a native of the West Indies. All the Cactaceæ are indigenous to America, no species appearing to be native of any other part of the world.



A LARGE CACTUS AT ANTIBES.

SOME people denounce labor-saving machines as an evil. They notice that a few individuals are put out of work for a time by the introduction of some device, but they ignore the greater benefits which the whole community obtain.

### Natural Gas.

A strong flow of natural gas has been struck at a point three miles northeast of Salem, S. D., at a depth of 60 ft. The pressure is strong enough to throw gravel and sand 30 ft. in the air. It has been tested and burns excellently.

A strong flow of natural gas was found recently in a well about two and one-half miles south of the city of Mattoon, Ill. The drill had penetrated but 100 ft.

A dispatch from Salinas, Cal., says:

"While boring for artesian water, recently, on a lot near the court house, a vein of natural gas was struck at a depth of 84 ft. At the application of a lighted match, the flames rose to a height of 10 ft. The gas also escapes around the pipe at the surface, and doubtless also at all of the different joints on the pipe, as they are not sufficiently tight to hold it. There is about 70 ft. of mud and slush in the pipe, and of course the quantity of gas that would necessarily be required below the mud to force to the surface what is constantly arising can only be conjectured.

"Gas veins have been struck here at different places years ago, but there is considerable more pressure and quantity in this well than in any of the others. It is estimated that gas sufficient to illuminate the entire city can be obtained from this vein."

The gas well struck just outside the city limits of Ogden City, Utah, recently, is creating much excitement there.

### Colloidal Cellulose.

Guignet states in the *Comptes Rendus* that cellulose is converted by sulphuric acid of 50° B. into a gelatinous transparent mass, which, when washed and dried, forms a milky solution with water. This solution contains colloidal cellulose, is unchanged on boiling, and is slightly dextro-rotatory. The cellulose can be precipitated from the solution by the addition of salt, sulphuric acid, or a large quantity of alcohol; it does not reduce copper solution, and gives no coloration with iodine. If the water be evaporated, and the residue touched with a drop of sulphuric acid, the colloidal cellulose is transformed into the insoluble variety. Artificial parchment, or parchment paper, seems to consist of ordinary cellulose in which the pores are filled with this colloidal variety, and can be prepared from filter paper by coating both sides with a solution of the colloidal cellulose, and then subjecting the coated paper to pressure between zinc plates.

### Giants of the Forest on Puget Sound.

Plying on Puget Sound is a boat 122 feet long. The timbers of which the hull is built run from stem to stern, and not one is spliced. As a specimen product a Washington lumberman sent to San Francisco last year a beam 24 inches thick and 152 feet long, writes a correspondent of the St. Louis *Globe Democrat*. He explained that his intention was to make it 190 feet long, but the end ran into a bank and the log had to be cut. Spars for ship yards on the Clyde, in Scotland, are shipped from Puget Sound. At a mill in Portland you may see the timbers, sawed, mortised, painted, and numbered, for bridges to be put together in Michigan, Ohio, and Indiana.

Puget Sound cedar shingles are used in New York State. Four ships are loading to-day at a Sound wharf, all with lumber. One goes to London, the second to Melbourne, the third to Valparaiso, the fourth to San Francisco. A test was made not long ago of 4 inch sticks of Washington fir, Michigan pine, and good white oak. The pine broke at 1,700 pounds, the white oak at 3,500 pounds, and the Washington fir at 4,300 pounds. Engineers say the straining force and endurance of this fir lumber is greater than that of any other. When one of these monarchs of the coast forest goes down, it shakes the ground like an earthquake. Let it fall across a canyon, and it doesn't snap under the tremendous shock, but lies intact and rigid.

There is a bridge in Oregon across a ravine 60 feet deep, made by spiking a plank on a tree where it fell by accident. Where a windfall in the forest has occurred, these great timbers lie so thick that the only way to cross is to walk on the trunks from 10 to 30 feet above the ground. Lumbermen tell of traveling for miles and not once putting their foot on the soil. In the old town of Tacoma, where the settlement was before the land company and the railroad made a city, there is a church with a fir tree for a steeple. St. Peter founded his church on a rock. St. Peter's Church of Tacoma has a tree for its corner stone. This tree has been cut off at a height of 50 feet, and upon the top is the belfry.

### Mines of Bolivia.

M. A. Carion, Belgian Consul-General at Santiago, in the last report to his government, states that the soil of Bolivia contains antimony, sulphur, bismuth, cobalt, cinnabar, copper, iron, nickel, ochers, gold under different forms, silver, saltpeter, salt, etc.

Discoveries of coal have lately been reported from Calacots and Achumani, which are situated at a little distance from La Paz. Copper is frequently found under a form called *charqui*; this consists of sheets of copper similar in appearance to thin slices of sun-dried meat, which is known as *charqui*, hence its appellation.

Marble, and more particularly that transparent description resembling alabaster, and which is called *berenguelas*, is frequently found, as are also earths suitable for the manufacture of faiences, tiles, etc., also kaolin, mineral waters, etc.

The principal copper mines are at Corocoro; these yield from 1,500 to 2,000 tons annually. In the Royal or Central Cordillera there are the silver mines of Esmoraco, Santa Isabel de Potosi, Chocaza, Huanchaca, Potosi, Colquechaca, Portugalete, Poopo, Huanuni, Antequera, Colquiri, Illemani, Guania, and others.

In the mountain chains of Lipez there are the mines of San Antonia, Ascotan, etc. Tin often accompanies silver in these various mines. Thus at Potosi there is a rich vein known under the name of La Bel Estano; at Oruro also there is one known as San Louis, and there are others at Huanuni, Colquiri, and elsewhere. The silver mines at Bolivia may be classed as follows: (1) Huanchaca, the production of which is steadily increasing; (2) Colquechaca, (3) Oruro, (4) Portugalete, and (5) Potosi.

### Anthrax Albumose.

In a communication to the *British Medical Journal*, (October 12, p. 811), Mr. E. H. Hankin claims to have isolated from anthrax cultures an albumose that is capable of exercising a marked influence upon the development of the anthrax disease. He states that when this albumose is injected into an animal in too large a quantity, it appears to cause death more quickly than an injection of the most virulent anthrax spores; but that when only a very small dose is injected, the system appears quickly to establish a tolerance of the poison sufficient to protect it against the subsequent action of the anthrax bacillus. If his conclusion proves to be correct, it would seem to point to an improvement in the method of vaccinating animals against anthrax and possibly against other diseases.

Mr. Hankin states that he isolated the albumose from anthrax cultures by the ordinary chemical method of precipitating it from solution by the addition of a large bulk of absolute alcohol, washing the precipitate thoroughly with absolute alcohol to remove ptomaines, drying, redissolving, and then filtering through a Cumberland filter. A rough colorimetric determination of the quantity of the albumose in solution was made by comparing the biuret reaction with that of a peptone solution of known strength.

### The Ingersoll New Catalogue.

The Ingersoll-Sergeant Rock Drill Company, of New York, has just issued a new catalogue, No. 8, in their series, covering the most important features in the mining of ores and coal, railroad tunneling and quarrying.

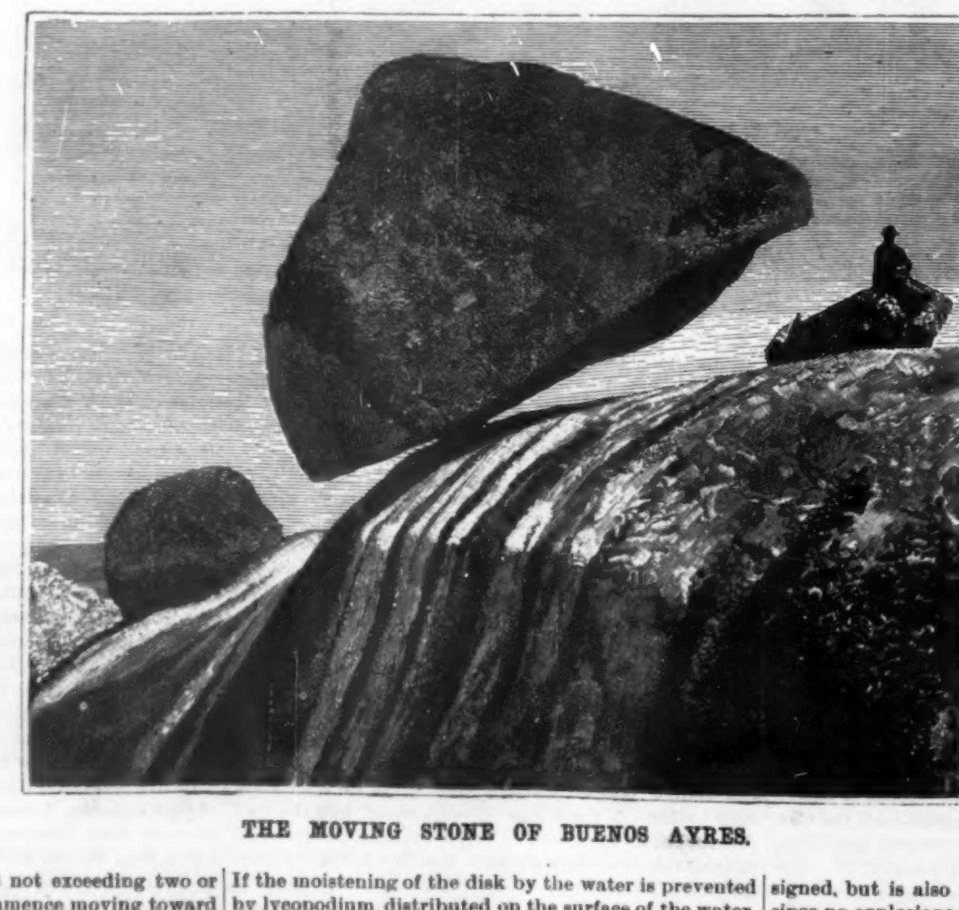
It is largely illustrated, not only with mining and quarrying machinery of the latest and most approved patterns, but also illustrates the American method of tunnel driving and submarine blasting, together with descriptions and adaptations of this class of machinery to the various conditions required in drilling hard and soft rock, such as granite, limestone, marble, sandstone, etc. A most important feature, that has heretofore been left out of catalogues of this class of machinery, is the price. In this catalogue the price, at a small advance on the cost, is inserted throughout the whole list of articles needed for mining and quarrying purposes, so that miners at a distance and in foreign countries can make up the cost of a complete mining plant without a tedious correspondence. The estimate sheets, with prices and shipping weights, are also a novelty in cataloguing this class of machinery.

The record of experience is so arranged as to give at a glance the prominent points in the progress and cost of mining and tunneling.

### THE MOVING STONE OF BUENOS AYRES.

The remarkable geological phenomenon which we reproduce in our engraving is located on the mountain of Tandil in the southern part of the Province of Buenos Ayres. It is called the moving stone, and is famous throughout South America.

This enormous rock appears to be sustained on its base by an invisible axis, and has an oscillating movement from east to west to and from the mountain, the power of a single man being sufficient to put it in motion. It measures 24 feet in height, 90 feet in length, and 18 feet in breadth. It represents a volume of over 5,000 cubic feet, and its approximate weight, as calculated, is 25 tons. Its figure is that of an irregular cone, and the base on which it rests has also the form of a cone which has a diameter of about 10 inches. When the wind blows from the south east the movable stone sways, rises, and falls after the manner of the branch of a great tree.—*La Ilustracion Española.*



THE MOVING STONE OF BUENOS AYRES.

### Rolling Stones of Nevada.

These stones are spheroidal, about the size of hickory nuts, of magnetic ferruginous composition, and are found in comparatively level regions where the surface is of rock.

They collect in the bottoms of shallow basins that abound in such localities, and lie huddled in bunches like eggs in a nest.

Distributed on a floor or other level surface, at distances not exceeding two or three feet, they immediately commence moving toward a common center with amusing celerity, caused, doubtless, by the material of which they are composed.

It is needless to add that they are usually devoid of moss.

### MOLECULAR ACTIONS.*

Cohesion and adhesion are forces which hold together molecules or ultimate particles. Cohesion unites molecules of the same nature. It is exerted strongly in solids, to a less degree in liquids, and very little in gases.

Heat causes the mutual repulsion of molecules, and thus diminishes the force of cohesion. Solids, when

A DEMONSTRATION OF COHESION.

strongly heated, expand, liquefy, and finally pass into a gaseous state, if not chemically changed at the temperature reached, *e. g.*, wood, leather, etc. The tenacity, hardness, and ductility of bodies is due to cohesion.

The force of cohesion in liquids may be demonstrated by suspending a disk by a delicate filament of elastic rubber, noting the extension of the rubber, then placing the disk in contact with a body of water, as shown in the engraving, finally drawing upon the rubber until the disk separates from the water. It is found that a considerable extension of the rubber is required to detach the disk. By a more delicate experiment, in which the disk is suspended from a scale beam, the force of cohesion may be accurately measured. It is found by this experiment that the material of the disk has no influence on the result, but that the weight required to detach the disk varies with the nature of the liquid. The fact that the disk retains a film of water after separation from the body of water shows that the force of cohesion of the water is less than the force of its adhesion to the disk.

Adhesion is the term applied to the attraction between the surfaces of two bodies. In the experiment illustrated the water adheres to the disk, and the force of adhesion in this case is superior to the force of cohesion as manifested by the molecules of the water. If the moistening of the disk by the water is prevented by lycopodium distributed on the surface of the water, there can be no adhesion.

Two pieces of plate glass pressed firmly together adhere strongly. This experiment succeeds in a vacuum, showing that atmospheric pressure plays no part in holding the glasses in contact.

In the arts, examples of adhesion are found in glues, cements, and solders.

* From "Experimental Science," by George M. Hopkins. Munn & Co. publishers, New York.

### Chloralamide.

The results following the administration of the new hypnotic, chloralamide, to a number of hospital patients have been communicated by Dr. D. R. Paterson, of Cardiff (*Lancet*, Oct. 26, p. 849). It was given in fourteen cases of insomnia, including simple sleeplessness and that consequent upon phthisis, heart disease, and enteric fever. Upon the whole, the results obtained were encouraging, for although the action of the amide is not quite so rapid as that of chloral hydrate, sleep coming on from half an hour to an hour after its administration, this is considered to be more than compensated for by the almost entire absence of action upon the circulation. The new hypnotic, however, appears to be not quite free from some of the disadvantages attending the use of others, since in some instances doses of 30 grains and 45 grains were followed by giddiness, feeling of sickness, dryness of mouth and even slight delirium. As a rule, sleep lasting about eight hours followed its administration, and in cases of phthisis its influence in restraining sweating was very marked; but the insomnia and restlessness due to pain were little, if at all, affected by it. Dr. Paterson thinks some of the published doses to be much too large, at least to begin with, especially if the patient has been ill some time. He has found that usually from 30 to 45 grains is sufficient for a man, while 20 to 30 grains will give satisfactory results in a woman.

### Prevention of Subway Explosions.

The frequent explosions of gas in the electrical subways in Chicago has led Professor Barrett, the city electrician, to devise a system of ventilation that has been put into use and found to work well. One of the causes that led to the active effort to find a way to ventilate the subways was that the escaping gas was finding its way, to a dangerous extent, into the city hall building. The *Western Electrician* says that the arrangement is now in operation in the basement of the city building, and consists of a chamber at the end of a tunnel entering the building, through the sides or walls of which the cables are carried for distribution, this chamber being provided with an air inlet and a vent connected with a flue, and so arranged that all objectionable gases coming through the tunnel will be carried off through the flue without being disseminated through the building. It will be understood that the tunnel is laid from the main conduit of the system, and is designed to carry the necessary conductors to the building. This conduit opens into the chamber or apartment. A door is provided, so that entrance may be had to the chamber. The cables are carried through the walls or sides of the chamber in any convenient manner, all spaces about the cables as they pass through the walls being practically air-tight, so that there may be no escape of gas into the building. An opening is provided between the chamber and outside, and a flue leading to the top of the building carries away the gas. This flue is preferably one of a stack of chimneys, so that it may be heated, thus causing a strong draught of air though the chamber. Any gas which may enter the chamber will thus be carried off through the flue. The gas in the conduits is also caused to circulate, and dangers from explosions throughout the system, as well as in the building, are avoided; while at the same time any annoyance from small quantities of gas entering the building is prevented. It is of importance to cause the gases throughout the system of conduits to circulate, since they are usually of such specific gravity that ventilation at the manholes does not have the desired effect. This invention is applied to the Chicago system of underground conduits, and not only prevents the explosions in the building for which it was specially designed, but is also beneficial throughout the system, since no explosions have taken place at the manholes or at other buildings connected with the same system since its application, and the injury to the cables heretofore caused by the action of the gases has practically ceased.

## RECENTLY PATENTED INVENTIONS.

### Engineering.

ROTARY ENGINE. — John B. Harris, Eutaw, Ala. The cylinder of this engine has radial slots into which inlet and outlet ports lead at opposite sides, the cylinder heads forming with the cylinder annular grooves into which the ports lead, and connecting with inlet and outlet pipes, while the piston is made star-shaped.

ORE SEPARATOR. — Alonzo C. Campbell, Nashville, Tenn. This separator has a reciprocating pan with a perforated false bottom, hinged gates resting on the upper face of the bottom, while there is a pipe for conducting water or air in the pan below the false bottom, with other novel features, the invention being an improvement on a former patented invention of the same inventor.

VIBRATION RECORDER. — John Milne, Croydon, England. This is an instrument to be used on locomotives and cars to detect imperfections in the track, and for the examination of vibrations of buildings, there being a pendulum to be operated by vertical vibrations, another pendulum by horizontal vibrations, and a third pendulum by horizontal vibrations in a plane at right angles to that of the second pendulum, all working in combination with a record cylinder carried by a clock movement.

### Railway Appliances.

DUMPING CAR. — John Voegtline and Gustaf Bergstrom, Republic, Mich. This invention provides an attachment designed to be readily applied to the ordinary form of platform car, whereby all such cars of a train may be dumped by the engine, the engine being attached to a series of connected cords, when a slight forward pull of the engine is sufficient to dump all the cars.

CAR COUPLING. — Andrew Drengson, Thompson, North Dak. In the drawhead of this coupling a coupling hook is pivotally mounted, and there is an open recess to receive the corresponding hook of another car, a hook-raising device being arranged within the drawhead, the coupler operating automatically, and being arranged for manipulation without the trainmen going between the cars.

### Mechanical.

SCREW DRIVER.—Charles G. Teubner, Lexington, Mo. This is a tool designed to clamp the head of a screw and hold it in fixed position while it is being driven in, the rod forming the body of the screw driver being adapted to fit a brace or to be received in a screw driver handle.

FOOT POWER. — James E. Adams, Ocean Beach, N. J. A drum is rigidly connected to a shaft on which a driving wheel is loosely mounted, a jointed lever being connected to the drum and a link connected to the drum and to the lever, the latter carrying a shoe arranged to engage the driving wheel, while bands connect the drum to the treadle and a spring, making a simple and cheap arrangement which can be run with little power.

SAW TABLE. — Joseph M. Baker, Louisville, Ky. This invention provides a mechanism whereby the material to be sawed may be automatically fed to the saws and suitably supported, there being a hopper at one side of a guide adjustable laterally, and having spring presses adjustably supported at its opposite side, the hopper being adjustable both as to length and width, and to permit the feeding of thick or thin boards, one or more at a time.

### Agricultural.

HAY AND STRAW SLING.—Joseph W. Wood, Baraboo, Wis. This invention covers a combination of an improved form of hook with a bottom trip hay and straw sling formerly patented by the same inventor, making a simple and effective device for binding and elevating hay or straw, affording space to receive the various ropes and chains, and whereby the load may be readily released after it is deposited in the desired place.

CHECK ROW PLANTING.—Franklin L. Menefee, Aurelia, Iowa. This invention provides a reel for check row corn planters, for unwinding or taking up the check wire, and means for automatically shifting the wire as it is wound upon the reel, and the reel is journaled upon a transverse bar rotating in the rear end of the truck frame of the planter, such bar being preferably the marker bar.

### Miscellaneous.

SPOKE DRAWER.—John M. Germann, New York City. This is a machine for drawing broken or damaged spokes from the hubs of wheels while repairing them, and has but few and simple parts, consisting of a couple of screws fitted to opposite threaded eyes of a spoke clamp, with foot or pressure plates adapted to bear upon the hub of the wheel.

HORSE DETACHER. — William B. Walker, Nevada, Mo. The shafts have recesses in which are fitted spring bolts, guide pulleys being arranged on the shafts and cross bar and each bolt connected to a cord passing to an operating cord, whereby the breeching straps and traces of a harness may be quickly released should the horse become refractory and uncontrollable.

REMEDY FOR DYSPEPSIA.—Oscar F. George, Black Brook, N. Y. This is a medicine made up of three different mixtures, separately compounded and mixed together as described, and containing glycerine, pepsin, hydrochloric acid, oil of anise seed, oil of gaultheria, cubebs, simple sirup, hydrastis canadensis, and other ingredients.

LIFE BOAT.—Peter F. Schenck, Navesink Highlands, N. J. This invention covers a rowing apparatus for use with closed life cars or boats, the boat having an oar opening in which is fitted a flexible diaphragm, while an oar with a hinged blade is fulcrumed to the hull and passed through the diaphragm, there being a latch on the oar operative within the boat to lock the blade in alignment with the oar body.

RIDING SADDLE. — Jesse D. Padgitt, Dallas, Texas. In this saddle the tree is divided, with a shortened seat leather, and the stirrup leathers, having a metallic straining piece upon them, pass entirely across the tree in front, against the front edge of the seat leather.

RIDING SADDLE. — Henry Ruwart, Jefferson City, Mo. This invention provides a saddle-tree having a combined wood and metal fork and horn that is very strong in proportion to its weight, the metal fork being so made as to require but little metal to give the necessary strength to keep it from spreading apart or breaking.

GRAIN TURNER.—Siegfried Hirschler, Worms, Germany. This is a machine for turning barley or other grain while undergoing germination during the manufacture of malt, the machine traveling on rollers supported by longitudinal rails at the sides of the floor, and its carriage having a wheel with shovels branching in opposite directions, to turn the grain on the backward and forward motion.

BALING PRESS. — Philip Steuerwald and Albert Cording, Sannemin, Ill. In this press the plunger is actuated by an elliptical shaped power head, pivoted centrally to a cross bar secured to the frame, the inner end of a sweep being connected to the head in such way that animals hitched to the sweep will rotate the head, the press being designed for easy operation by farm hands or ordinary laborers.

BEAM COMPASSES. — Henry W. Oliver, New York City. This is an improved drawing implement combining various instruments, the extension beam having an adjustable leg carrying a pointer, a knob turning loosely on the leg, a holder carrying a pen, pencil and other point, and a second knob held to turn loosely on the holder.

BUTTON FASTENER.—John P. Hickey, Washington, D. C. This fastener is designed especially for fastening buttons to trousers and other garments, the shank being adapted to carry the button at one end and having its other end bent in peculiar shape, to be passed through the fabric and locked thereto.

LACE FASTENER. — Martin N. Bailey, New York City. This is a fastener for laced shoes, made of a single piece of wire formed into a full coil and a partial coil integral therewith, to rest on the outer side of the shoe flap, a hook-like extremity passing through the flap, and a coil resting upon its inner side, whereby with a single motion the lace is securely clamped.

BAKER'S OVEN.—John Raney, Brooklyn, N. Y. This is an oven in which there is no communication between the baking chamber and furnaces through the floor of the chamber, and is so constructed that the temperature of the baking chamber may be easily controlled, as required for different articles, without undue disturbance of the furnace fires.

WALL POCKET. — George Baldwin, Willimantic, Conn. This pocket has an essentially U-shaped bottom to which standards are secured with grooves upon one face, into which fit detachable front and rear boards, making a simple and economical pocket for papers, scraps, etc.

WINDOW SCREEN.—William D. Graves, Jr., Presque Isle, Me. This is a screen which may be extended lengthwise and have its sides continuous without shoulders or offsets, so that the surface of the frame adjacent to the sash will fit, and prevent the ingress of flies or other insects, the screen having end pieces attached to the sections offsetted to project the face of the screen close to the lower sash.

SHUTTER FASTENER. — George Bensel and Otto T. Maier, New Orleans, La. This is a fastening which permits the opening of doors and shutters on which it is used from the outside in case of fire, pins supporting the lock and projecting to the outside, and having an annular groove near the outer end, a collar on the outer end of the pin terminating at the groove.

ROTARY FAN. — Oscar S. Heckle, Macon, Ga. This invention covers a construction by which the entire fan shafts and fans, in a series of fans, can be adjusted and raised or lowered as desired, and readily secured in their adjusted positions by set screws, the fans being adjustable to stand at any desired angle, while the construction is strong and simple.

CLOTHES PIN.—Charles Barlow, Cookshire, Quebec, Canada. This invention relates to wire clothes pins, and is designed to so improve the construction of the pins as to provide for the ready and effective clamping of heavy and light garments on the line.

COLORED FIRE.—John G. Stuttz, San Diego, Cal. This invention relates to a compound constituting a body for illuminating or colored fires, the body being a hard, compact mass that is harmless in burning, makes little or no smoke, and is also a good disinfectant, while it is designed to burn longer, brighter, and stronger than any similar composition, the composition not being affected by weather, and giving out little or no odor in burning.

ANIMAL TRAP. — James F. Warnick, Eugene, Ore. This is a self-setting device by which rats and other rodents may be captured alive or thrown into a water tank and drowned, a trap board being pivoted at the front end of a frame, a screen-covered cylindrical roller engaging a pin in the trap board and there being a pivoted bait box in the rear of the trap, with other novel features.

## NEW BOOKS AND PUBLICATIONS.

CHEMICAL TECHNOLOGY, OR CHEMISTRY IN ITS APPLICATIONS TO ARTS AND MANUFACTURES. Edited by Charles Edward Groves, F.R.S., and William Thorp, B.Sc. Vol. I. Fuel and its applications. By E. J. Mills, D.Sc., F.R.S., and F. J. Rowan, C.E. Philadelphia: P. Blakiston, Son & Co. 1889. Pp. xx, 802. Price $7.50.

This the first volume of what will be one of the most important contributions to technical literature of the day. In it we find treated in detail and with very numerous illustrations, tabular statements, diagrams, and other adjuncts, the titular subject. Heating in its various modifications as regards houses, factories, blast furnaces, boilers, kilns, cupolas, etc., finds a place. The methods of using liquid fuel are treated in great detail, and natural gas is included also. The subject of coal is supplemented by very numerous analyses of the coals of all parts of the world, and a considerable portion of the book is devoted to direct experiments, as conducted in England and America, with various coals. The present volume is interesting as a sample of the thoroughness with which the entire ground of chemical technology promises to be covered in this series.

THERMODYNAMICS, HEAT MOTORS, AND REFRIGERATING MACHINES. By De Volson Wood, C.E., M.A. Third edition. New York: John Wiley & Sons. 1889. Pp. xi, 452. Price $4.

The subject of thermodynamics is treated in this work by the higher mathematics. Professor Wood is well known already to our readers from his important contributions to the SCIENTIFIC AMERICAN on this and similar subjects, and in this work the same high qualities as mathematician, reasoner, and expounder of engineering science are found that have always been recognized in the articles above referred to. An exceedingly interesting portion of the work, and one which deserves special consideration, is Appendix I., on the luminiferous ether and the theoretical properties of this hypothetical body. The second law of thermodynamics is treated in considerable detail, and as there is no subject in thermodynamics more worthy of study than this, its full treatment adds considerably to the value of the work. It is illustrated where required, and forms a very important contribution to the literature of technical science.

EVERY DAY BIOGRAPHY. By Amelia J. Calver. New York: Fowler & Wells Co. 1889. Pp. 378. Price $1.50.

This compilation is one which is of interest to all. In it, under every day of the year, are given the dates of the births of eminent people in every department of life, especially those of literary men and women. Thus, under each day are found one or more names of notables born upon that day, with an abstract of the life of each, and date of death, in case the person or persons have expired. An analytical index and a separate alphabetical one make all the names given easy of reference and quickly to be found.

RECENT ECONOMIC CHANGES AND THEIR EFFECT ON THE PRODUCTION AND DISTRIBUTION OF WEALTH AND THE WELL-BEING OF SOCIETY. By David A. Wells, LL.D., D.C.L. New York: D. Appleton & Co. 1889. Pp. xii, 493. Price $2.

The science of political economy with reference to capital and labor, riches and poverty, forms the topic treated in this work. It is made of concrete and immediate interest by the consideration of the developments of modern times, such as the use of natural gas for fuel, changes in former industries, overproduction of iron, revolution in the carrying trade, the evils of the bounty system, influence of machinery on wages, and other live topics. It is evident from this very short *resumé* of the ground covered by it of what general interest it is. Mr. Wells is such a well-known authority on the subject of which his book treats, and has passed so much of his life in study upon the great political and national questions of the day, that this work will be sought after and read with especial relish by those who are interested in the well-being of society and who look to the continuance and fortifying of our best methods and the suppression of our national faults.

TRANSACTIONS OF THE EIGHTEENTH AND NINETEENTH ANNUAL MEETINGS OF THE KANSAS ACADEMY OF SCIENCE. Vol. X. Topeka, Kansas. 1887. Pp. 155.

The tenth volume of the "Transactions" shows well the active scientific life of our Western centers. It is devoted largely to geology, and will be found full of interesting scientific information.

CHEMISTRY: General, medical, and pharmaceutical, including the chemistry of the United States Pharmacopœia. By John Attfield, F.R.S. Philadelphia: Lea Brothers & Co. 1888. Pp. 770. Price, cloth, $2.75; leather $3.25.

Although the present work is primarily a manual of chemistry for the physician and pharmaceutist, the topics it covers really include all chemistry, with amplifications on the subject that apply especially to medical and pharmaceutical work; in fact, the ground which is somewhat neglected in the general works is found covered here. The book, while in a certain sense a *sine qua non* for the student of medical chemistry, will be found an admirable supplement to most of the larger chemistries for the general chemist. It is illustrated where required.

CYCLING ART, ENERGY, AND LOCOMOTION. By Robert P. Scott. Philadelphia: J. B. Lippincott Company. 1889. Pp. 305. Price $2.

The art of cycling is properly one of the developments of the day. It has so increased the power of locomotion for men and women that in every region where the roads are at all suitable it has acquired astonishing extension. In the present book the subject is treated in a manner that is at once lively, interesting, and scientific. The possibilities of the art are given due space, and the many ideas of inventors are illustrated and described, in some cases with a slight sarcasm that displays fully the over-sanguine ideas of these persons. The book is illustrated with a great many diagrams and views of different types of wheels, not the least interesting being a portrait of the author upon his original velocipede of 1868-69 and one of Gavin Dalzell mounted on the "original rear driver safety" of 1845. The mechanics of cycling are here given in admirable shape, and all scientific cyclers should read the book.

PRACTICAL ELECTRIC BELL FITTING. By F. C. Allsop. London and New York: E. & F. N. Spon. 1889. Pp. xii, 142. Price $1.25.

The title of this work sufficiently indicates its scope. It is an eminently practical treatise on the work of fitting houses with electric bells and general fire signaling devices: 141 illustrations are embodied in the text in the proper places to illustrate the matter treated.

*Received.*

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## Notes & Queries

### HINTS TO CORRESPONDENTS.

**Names and Address** must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

**References** to former articles or answers should give date of paper and page or number of question.

**Inquiries** not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

**Special Written Information** on matters of personal rather than general interest cannot be expected without remuneration.

**Scientific American Supplements** referred to may be had at the office. Price 10 cents each.

**Books** referred to promptly supplied on receipt of price.

**Minerals** sent for examination should be distinctly marked or labeled.

**(1567) W. S. asks: 1. What is Paris** green? A. It is a complex salt of copper, arsenic acid, and acetic acid. Sulphate of copper 50 pounds and lime 10 pounds are dissolved in vinegar 30 gallons, and a boiling hot solution of white arsenic 50 pounds is added thereto, the mixture is stirred, allowed to settle, and the residue is ground and powdered. This is Schweinfurth's green, and adulterated forms Paris green. It contains before adulteration:

| | |
|---|---|
| Copper oxide | 31·24 per cent. |
| Arsenious acid | 58·12 " " |
| Acetic acid | 10·14 " " |

2. What is London purple? A. London purple is a residue from the manufacture of aniline. Its color is due to the dye, and it consists essentially of arsenic acid.

**(1568) S. asks: Can a man by applying** the same power on a 36 inch screwdriver turn a larger screw or drive the same size screw farther into the wood than he can with one one-half that length? Both screwdrivers are to be of the same material, the same size handle, and same at point. A. Yes. The large size gives a better scope for power and grip. According to one theory, the handle of the screwdriver, from its outside edge to a line parallel with the center of the screw, forms a crank lever. With the longer handle the leverage thus obtained can be proportionately increased by a hardly perceptible inclination of the tool, not affecting the hold of its bit in the slot of the screw.

**(1569) G. W. asks if it is necessary for a** student (taking a mechanical drawing course) to make free hand sketches of wooden models, such as cubes and prisms and vases. Would it not be better to make free hand sketches of parts of machinery and tools? A. The method of teaching should be adapted somewhat to the student's abilities. For a beginner the block system is used to rectify the eye. When the eye becomes schooled to bring out block figures with their edges straight and at the proper angles, or in perspective, it is time to attack more complex parts. If you have reached the stage of correct delineation, a higher style of free hand sketching is in order.

**(1570) J. T. F. asks: How can gas be** separated from water and be stored up in a reservoir so as to be under pressure to be used as fuel and light? For instance, in the Brazos Bottoms (Texas) there are many artesian wells which throw forth a stream of water and gas mixed. There is enough gas to light with a match. A. The well should be piped, the same as usual with gas wells, so as to lead the gas and water into a large tank, where the gas will separate from the water and occupy the upper part of the tank, while the water settles at the bottom and may be discharged through an inverted siphon, so as to retain any desired pressure in the tank. The tank should be strong enough to resist the pressure of the well, when the outlets are closed. In this way the flow of gas need not be wasted, and the well be made to flow only when the gas is required for use.

**(1571) V. M. writes: I have a new en**gine 3½×5, to run about 300 revolutions, takes steam ⅝ of stroke. What power will it develop at 100 pounds pressure? I want to get up a 1 inch coil pipe boiler. How many coils and what length must they be to supply this engine and not foam or prime injuriously? A. You will be able to develop about 5 horse power with your engine, and will not need less than a four horse power boiler. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 709, for illustrated description of small coil and pipe boilers, which may be made on a larger scale for your purpose. See our advertising columns for houses furnishing materials.

**(1572) F. Van den B. writes: At a depth** of 2,000 feet here in drilling oil wells we strike salt water, which rises to a height of 1,800 or 1,900 feet in the well. We are here about 1,000 feet above the level of the ocean, about 300 feet above Pittsburg, Pa. Now, where does it come from, and whence its pressure for such an elevation? A. Water seeks its own level. The water does not come from the sea, but probably from the Allegheny mountains and perhaps other hills, finding its way through pervious strata, on the principle of the artesian basin.

**(1573) P. S. asks for a receipt for** making brewer's pitch. A. We give two formulas: *a.* Light yellow.—Melt in an open boiler 100 pounds of pine pitch, and add with constant stirring 5 to 6 pounds of caustic soda lye of 10° Baume. When frothing ceases and the pitch is in quiet fusion, it is poured into iron moulds. *b.* Brown.—Melt in an open boiler 30 pounds pine pitch, 175 pounds brown resin, and 10 pounds heavy rectified resin oil.

**(1574) W. H. H. M. asks: 1. What pre**paration is used to give a glaze on enameled cards, etc.? A. The glaze upon enameled cards is made by pressure upon a polished plate or rollers. The composition is chalk, clay, and a little starch. Good work is not possible without elaborate accessories. 2. A good solution for removing the blue from steel so as to leave as clean as before coloring. A. Try acetic acid, or solution of chloride of tin (stannous chloride).

**(1575) F. W. D. asks for a cheap alloy** that will run sharp, and not stick to an iron mould. Should be a little harder than lead, and less expensive than the bismuth alloys. A. Two parts tin to 1 part lead makes a fine alloy, a little harder than lead. But for very fine and sharp lines there is nothing better than type metal: 3 parts lead, 1 part antimony, and 1 to 2 parts tin.

**(1576) J. W. C. asks the correct way of** spelling the name of Stubs as related to the wire gauge. A. Stubs is the proper name. Stubs' gauge is correct, but as Mr. Stubs has made various gauges, such designation always requires explanation. As used here it generally signifies the Birmingham gauge.

**(1577) J. G. W. asks for the cubic con**tents of a hot air balloon to lift 200 pounds. A. A fair supposition is that the air would be doubled in volume. Then each cubic foot would have a lifting power of 268 grains, or for 200 pounds nearly 5,300 cubic feet would be required. 2. The best low-priced material. A. Cotton sheeting. 3. Quantity of material? A. About 1530 square feet. 4. Whether gores should run horizontal or perpendicular? A. Perpendicular. 5. What dressing for material? A. Good quality of varnish. See SUPPLEMENT, No. 736, for an excellent paper on balloon construction.

**(1578) C. M. H. and C. C. B. are referred** to answer to query No. 1324 for polishing horns, in our issue of September 28, 1889.

**(1579) C. E. P. writes: Can you advise** me about procuring a "No. 1" receipt for manufacturing cider without apples, and also what is used to make it keep for any length of time without becoming sour?

| | |
|---|---|
| A. Soft water | 25 gal. |
| Tartaric acid | 2 lb. |
| New Orleans sugar | 25 lb. |
| Yeast | 1 pt. |

Put into clean cask with bung out, and allow to stand twenty-four hours. Then add three gallons spirits and let stand forty-eight hours. It will keep well if not left exposed to the air, and if the cask is sweet. There are other and more complicated receipts in Dick's Encyclopedia, which we can supply for $5.

**1580) R. A. H. and others.—To get a** fine polish on such stones as quartz, granite, etc., grind the surface on a grindstone, the last grinding being very light, and then rub with ground pumice stone and water on the end of a piece of wood or on a piece of sole leather, finishing with a piece of sole leather with oxide of tin or rouge, wet. The same process will answer for polishing geological specimens, such as coral, onyx, jasper, etc. A piece of felt or heavy woolen cloth tacked on a board also makes a good polisher. An ordinary lapidary's outfit consists of appliances not usually kept on sale, but which any machine shop can readily furnish. You will need a frame with wheel shaft and spindle, with several lead laps, one for coarse, and one for fine emery, and one or more for polishing, also a lap made with end wood on a chuck for polishing, and a leather polisher, desirable for rounded work. A thin disk of copper mounted on ordinary lathe spindle is used for slitting with emery. In using diamond dust, which is employed in working on diamonds and in some other cases, a sheet steel disk, very thin, should be used.

**(1581) J. M. S.—You will probably not** be able to solder a cast iron kettle that is cracked or leaking. It is with much difficulty that pure tin can be made to stick to cast iron; it will not flow into and unite the edges of a crack or fill a small hole.

**(1582) W. L. B. asks: Will the follow**ing engine yield four horse power: Diameter cylinder, 4 in.; stroke cylinder, 5 in.; revolutions per minute, 300; steam pressure, 40 lb.; cutting off at ¼ stroke; automatic cut-off. Please show figuring by which you arrive at rating of engine. A. The clearance should be given. It may be taken as 5 per cent for so small an engine. To obtain mean steam pressure, let

P = total pressure = 40 lb.
C = clearance = say 0·25.
$e$ = length to cut-off = 1·25 inches.
L = length of stroke = 5 inches.

Then mean pressure is equal to

$$\frac{P\left[(e+C)\left(1 + \text{hyp. log}\,\frac{L}{e}\right) - c\right]}{L} =$$

$$\frac{40\left[1^{25}\left(1 + \text{hyp. log}\,\frac{5}{1\cdot25}\right) - 0\cdot25\right]}{5}$$

$$\text{then hyp. log}\,\frac{5}{1\cdot25} = 1\cdot3863, \text{ and}$$

reducing, we have as mean pressure 26·63 lb.

Area of cylinder = 12·56 square inches.

$$\text{Piston travel} = \frac{3000}{12} = 250 \text{ feet.}$$

$$\frac{12\cdot56 \times 26^{63} \times 250}{33{,}000} = 2\cdot534 \text{ indicated horse power.}$$

From this about 10 per cent must be subtracted for friction and leakage

**(1583) J. L. writes: A manufacturer,** burning a large amount of soft coal has five chimneys in a row about fifty feet apart, with two kilns leading into each chimney, and the chimneys are about sixty feet high. The smoke from the chimneys carries a large amount of soot, or lampblack, which is scattered over the immediate neighborhood, making a great nuisance. Now, if this party should build one large stack one hundred and twenty-five feet high, the kilns all leading into it, would the smoke nuisance be materially lessened, or would the same nuisance be more distributed? A. The one large chimney will not make less smoke, although it will carry the smoke to a higher point, so that it would be carried away in windy weather. We recommend a better method of managing the fires. There are smokeless furnaces for soft coal in use. See SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 71, 320, 424, for illustrated smoke-burning furnaces.

**(1584) W. H. B.—The government has** not offered any reward for the discovery of perpetual motion. The power of a horse is very variable. The average of actual trials is 20,000 lb. raised one foot high per minute, for continual work, the mechanical horse power being 33,000 lb. raised one foot per minute. There is a strong possibility that iron fence posts will come into more general use in a few years. They are now used to a limited extent for wire fences, and are subjects of several patents. Useful effect of windmills varies with their size; small mills obtain about 40 per cent of the wind force, larger mills 50 per cent.

**(1585) G. H. N. asks: Which is the** most expansive when heated—soft-drawn iron, soft-drawn Bessemer steel, hard drawn Bessemer steel, or ordinary machine steel? A. There is very little difference in expansion by heat for iron or low steel with so little difference in the carbon element, which decreases the amount of expansion. Its amount is less than $\frac{1}{10000}$ of an inch for each degree of difference in temperature for 100 feet in length, the pure iron having a greater expansion than the Bessemer and machinery steel. The difference between hard and soft steel is imperceptible.

**(1586) C. J. writes: Will you inform** me how to take glass stoppers from bottles which are so tight that the hand cannot turn or twist them. They were used to hold potassic carbonate, $K_2CO_3$, which is in them at present, also baric hydrate, Ba $H_2O_2$. A. The most radical way is to heat the necks in a gas or alcohol flame and try to twist the stoppers while doing this. If carefully done, this will sometimes succeed where every other method fails. There is great danger of cracking the bottles. A string may be secured loosely between two fastenings on the same level. A turn is taken with the string around the neck of the bottle, which is then pressed down and rubbed strongly back and forth until the neck is very hot, when the stopper can sometimes be removed.

**(1587) G. M. T. asks for the best** means of boring rubber stoppers. A. Use a sharp-edged brass tube as thin as possible, and lubricated with soap and water. The hole will be a little smaller than the tube. It may be done by hand, or the tube may be chucked in a lathe. The tube is to be rotated and pressed against the stopper.

**(1588) H. B. writes: Would you inform** me as to the best method of producing a solid or imitation gold plating, to be used cold (without battery)? Durability is not essential. A. Use an ethereal solution of gold chloride. Absolutely neutral gold chloride is dissolved in as little water as possible, and is placed in a separatory funnel with three times its volume of ether. The funnel is closed and the whole rolled about a few minutes, allowed to stand 24 hours, and the liquids separated. The ethereal liquid is kept in tightly closed bottles.

**(1589) A. L. S. asks: What to use to** color leather a blood red, as used in making saddles. A. Brush the leather with a solution of sulphate of ammonia, and apply the dye. Use either aniline red or extract of alkanet root (alkanine). Work rapidly to prevent the dye penetrating the leather.

**(1590) G. H. B. asks if salt added to** whitewash will make it more adhesive, and if glue would still further improve it? A. Salt is often added, but does not improve it much. Glue is useful only in indoor work. See answer to query 377.

**(1591) A. B. F. asks if it pays to tar** manila ropes which are exposed to the weather and in constant use, such as hoisting electric street lamps. A. Running ropes should not be tarred. They do not last as long as the untarred ropes.

**(1592) F. B. asks: 1. Is the Sharpie** yacht boiler described in SUPPLEMENT, No. 182, large enough for a 2¾ by 3 engine? A. Yes. For a trifle less speed than the Sharpie yacht. 2. What size feed pipe will it need? A. ⅜ in. feed pipe. 3. How heavy, and what diameter, should the flywheel be? A. Flywheel size should be governed by the room that you can make for it; 10 in. is large enough; about 15 lb. 4. Is a pump ¾ by 1⅛ the right size, or would it be better to run it from the crosshead, and what size plunger? A. ½ in. pump; from the crosshead is best. 5. What pressure will the boiler stand with safety? A. If boiler is properly made, should be safe at 125 lb. pressure. 6. At what speed should the engine be run? A. Engine should run 250 revolutions per minute. 7. What power will it be? A. Two horse power. 8. Will it be necessary to have a heater? A. Not necessary to have a heater, but a heater properly constructed would modify the noise and nuisance of the exhaust. 9. What will destroy a wart on the eyelid, without injury to the eye? A. We do not know. Better consult a physician if the case is a very bad one.

**(1593) W. G. H.—We know of nothing** better to varnish new copper work than boiled linseed oil. It stands the weather as well as the best coach varnish; although it does not make quite as smooth a surface, it is much cheaper. Two coats are sufficient. Let one dry thoroughly before the second is applied.

**(1594) R. M. asks for a good gold or** gilt lacquer for polished brass work. A. Use lacquer made of shellac and alcohol colored with dragon's blood or turmeric to suit your taste.

**(1595) J. N. H. asks: 1. How are tubes** bent so as to have a curve devoid of seams? A. They are generally filled with lead or resin before bending, and afterward melted out. A spiral spring mandrel is often used. 2. What can I do to make cast iron field magnets compete in efficiency with wrought iron in an electric motor? It is not convenient for me to make the cores of wrought iron, on account of shape. A. A field magnet of soft gray cast iron answers a good purpose, but it is not quite equal to wrought iron.

**(1596) Galatea.—The illusion of Galatea,** a living head, changing into a plaster bust, then into a bunch of flowers, etc., is fully illustrated and described in our SUPPLEMENT, No. 630.

**(1597) J. B. S.—The earth is assumed** to be a great magnet, or to have currents of electricity continually circulating around it, to which the magnet arranges itself at right angles. The magnetic pole is constantly changing its position. No cause for these phenomena is known.

**(1598) J. E. B. — We believe the min**eral contains no metal of value.

**(1599) H. S. asks if there is any chemi**cal that is sensitive to red light and not to actinic. A. Not as regards chemical change. Of course the heat of the red rays being greater than that of the more actinic rays may bring about chemical change by increase of temperature.

**(1600) W. S. D. asks: Is there any way** to clean gold or gilt military braid? A. This is a somewhat uncertain operation. One old method was to bake the articles in a loaf of bread. This was used for epaulettes. On extracting them from the bread, they came out cleaned. Another receipt is to rub the braid stretched out flat with the finest powdered and sifted burned alum, applied with a soft rag.

**(1601) W. H. H. asks how the follow**ing inks are made: Green, violet, scarlet, black, blue, and brown, for automatic shading pens. How to put up the powders for making them; and how waterproof inks are made, and how is adhesive ink made? A. All these inks are made with aniline colors for a basis, mixed with gum arabic and water. The powders are simply mixtures of aniline colors with powdered gum arabic. Adhesive ink contains enough gum arabic to give it body. For waterproof inks substitute for mucilage a solution of shellac in strong borax water.

**(1602) L. H. H. asks: 1. Is there any** practicable method of extracting the moisture from a current of air without the application of heat or cold, so that by circulating in a circuit it could be applied for drying purposes? A. By passing the air over dry chloride of calcium, it will be deprived of moisture. Oil of vitriol will give the same result. From time to time new chemicals must be used, or the spent chloride of calcium may be revivified by drying at a high heat. 2. Is there any means of cleaning a plaster centerpiece that has been discolored by smoke? A. Have it cleaned and calcimined by a good workman. It will not stand hard scrubbing, and the smoke can never be perfectly removed.

**(1603) Ignorant asks: 1. How to cure** corned beef? A. There are many receipts. We give one. To each gallon of water add 1⅛ lb. salt, ⅛ lb. sugar, ⅛ ounce saltpeter, and ⅛ ounce potash. Boil, skim, and when cold pour over the meat. 2. If when in pickle it should freeze, would it injure meat any? A. Freezing will not be likely to affect it if properly cured. A very severe cold will be resisted on account of the presence of so much salt.

**(1604) M. J. B. asks how to keep store** windows from sweating; our windows are closed on inside from top to bottom, and we use Siemens-Lundgren gas burner. A. Ventilate your windows from the top, or if possible arrange a ventilating hood over each burner, carrying the products of combustion into the open air. These are the only radical cures.

**(1605) H. P. says: 1. I desire to experi**ment with a simple acoustic telephone. What amount of expansion will there be in 500 feet of copper wire No. 20 in the change of temperature from coldest winter to heat of summer? A. 5¾ inches for 100° change in temperature. 2. Can an electric bell be successfully rung over such a wire? A. Yes. 3. What would be the best way to arrange the battery, and what kind of battery would be best? A. Use an earth connection for one circuit, and any of the batteries described in SCIEN-

TIFIC AMERICAN and SUPPLEMENT, Nos. 369, 388, for electric bell work. 4. What is the best method of turning corners in such a telephone? A. Turn the corners with a double sling of rubber, so as not to make a sharp or right angle. 5. How long a line can be used successfully? A. 500 to 800 feet. 6. What is best material for diaphragm, and how large should it be? A. Very thin steel or tin plate No. 30 to 32 wire gauge, varnished, 3 to 4 inches diameter. 7. Where can I find a description of the simplest method of operating a number of dials from one clock movement by electricity? A. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 198, for illustrated description of electric clockwork. 8. Is the use of platinum wire absolutely necessary in electric bells where there is slight friction between contacts, or in single-stroke bells? A. Platinum contact points are not necessary for experimental work. 9. What is the price of platinum wire, say about 16 gauge, and where can it be obtained? A. Platinum wire, $10 to $12 per ounce, can be procured from H. M. Raynor, 25 Bond Street, New York. 10. Is it true that common flat irons do not retain heat as well after having been in use a long time? A. It is generally conceded. There is some molecular change by long heating of iron. 11. Does the recoil move the barrel of a gun at all before the charge has left it? A. Yes; the recoil commences at the instant of ignition or first movement of the ball. 12. Is the movement caused by the inertia of the charge or by the gases blowing out of the muzzle? A. The pressure caused by the burning of the charge acts upon the ball to push it forward, and upon the breech area to push the gun backward nearly in the ratio of their weights, and is continued in a less degree while the gases are blowing from the muzzle. 13. Are there other causes? If so, please state them, and tell which is the principal one. A. Reaction is the principal cause.

(1606) J. L. W. asks: Is there any way of holding a fountain pen, the nozzle of which has become fastened? Have not sufficient grip in fingers to hold. A. Try a small flat piece of India rubber band. Or cut out of two pieces of wood two grooves that will almost exactly fit the circle to be gripped, and grip it between them. Cork may be used if cut of proper shape. If the grooves are too large or too small, the barrel may break.

(1607) W. G. M. asks: 1. Was the Serpollet boiler described in the SUPPLEMENT of September 22, 1888, a success? A. We do not know. That class of injection boilers have had many trials and as many failures. They choke up with the solution of mineral and other substances in ordinary water and burn out. 2. Can a barrel be made airtight so that fruit can be sealed and preserved in it, and can it be filled full of cold water and sealed so to exclude all air and not be in danger of bursting, being kept where it will not freeze? A. Probably not, at least in a practical way. It is difficult to make an absolutely perfect vacuum, even for experiments, and there is air in the pores of all fruit, as well as in water in its natural state. 3. How long from the seed will it take the mahogany tree to attain twelve inches in diameter, and at what size and how long till it will begin to be valuable if cultivated for profit? A. The tree cannot be grown here. It requires a tropical or sub-tropical climate. It is of comparatively quick growth, but this varies according to the location and the kind of mahogany, some descriptions being spongy and of little value. Some trees attain an age of two hundred years. 4. Can iron be melted by using charcoal in place of coal or coke? A. Yes; charcoal makes the best heat for melting iron, and was always used before the discovery of other kinds of coal. 5. If a two horse power engine propels a boat ten miles per hour, at what speed will a four horse power engine propel it? A. The 4 horse power engine will propel the boat about 13 miles per hour, provided that you also increase the size of the wheel proportionally.

(1608) T. S. K. asks: 1. What makes a shotgun kick? A. The reaction of the shot and gases suddenly expelled. 2. How does a spider get his web stretched from one side of the street to another? A. All of a spider's ways have not yet been explained. He is supposed to take advantage of wind in some of his operations for carrying his web filaments.

(1609) L. F. asks for a receipt for making baking powder. A. Mix 9 parts bicarbonate of soda, 8 parts tartaric acid, and 10 parts rice flour. Keep dry.

(1610) C. G. H. writes: A claims that the compression curve of an indicator diagram from a condensing engine is caused by the gradual destruction of the vacuum in the cylinder, which raises the pencil of the indicator to the atmospheric line, and that compression does not begin until the pencil reaches that point, the atmospheric line. B claims that the compression curve is caused by a portion of the exhaust steam being imprisoned in the cylinder by the closure of the exhaust valve before the piston reaches the end of its stroke, and is compressed into the clearance space, and that compression does begin as soon as the exhaust valve closes, and that no vacuum really exists in the cylinder; the expansion line falling below the atmospheric line is the effect of the vacuum in the condenser. Which is right? A. A is right. There is no compression on the vacuum side. The loss of the vacuum, which may be by leakage after the closing of the valve, makes the appearance of compression, but which is only a relief. With a 27 inch vacuum there is too little exhaust steam left in the cylinder at the closing of the port to produce compression, especially if there is any material clearance. Leakage often makes very inexact work with theoretical lines on an indicator card.

(1611) E. W. McD. asks for a formula for the preparation of liquid glue for tableting purposes which can be applied cold and which will retain its elasticity. A. Use solution of gutta percha in bisulphide of carbon.

(1612) J. H. C. asks if there is a mountain peak higher than Mt. Everest. A. Mount Everest is the highest, 29,002 feet. There was a report of a higher mountain in the Himalaya group, of which we have no exact information.

(1613) F. R. asks for a formula for making an ink from which a copy can be taken, by using the copying paper simply as though it were blotting paper, i. e., no press, no wetting. A. Use aniline ink containing a large proportion of glycerine.



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**November 19, 1889,**

**AND EACH BEARING THAT DATE.**

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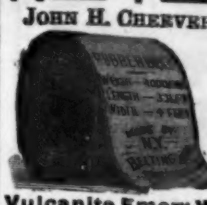

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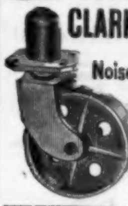

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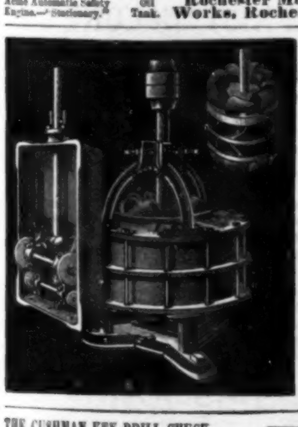

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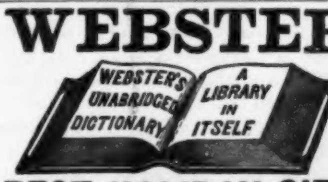



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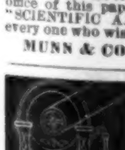

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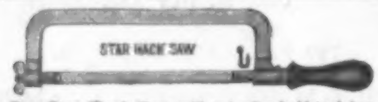


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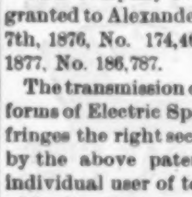


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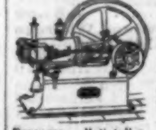

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